DOCUMENT RESUME

ED 421 661 CE 076 948

AUTHOR	Hilley, Robert
TITLE	Power Product Equipment Technician: Construction Equipment. Teacher Edition. Student Edition.
INSTITUTION	Multistate Academic and Vocational Curriculum Consortium, Stillwater, OK.
PUB DATE	1999-00-00
NOTE	238p.
AVAILABLE FROM	Multistate Academic and Vocational Curriculum Consortium, 1500 West Seventh Avenue, Stillwater, OK 74074 (order no. 800061, teacher edition; 800062, student edition).
PUB TYPE	Guides - Classroom - Learner (051) -- Guides - Classroom - Teacher (052)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Academic Education; Behavioral Objectives; Competence; *Competency Based Education; Construction Industry; *Engines; *Equipment Maintenance; Integrated Curriculum; Job Skills; Learning Activities; Lesson Plans; *Power Technology; Regional Planning; Secondary Education; *Small Engine Mechanics; Teaching Guides; *Technology Education

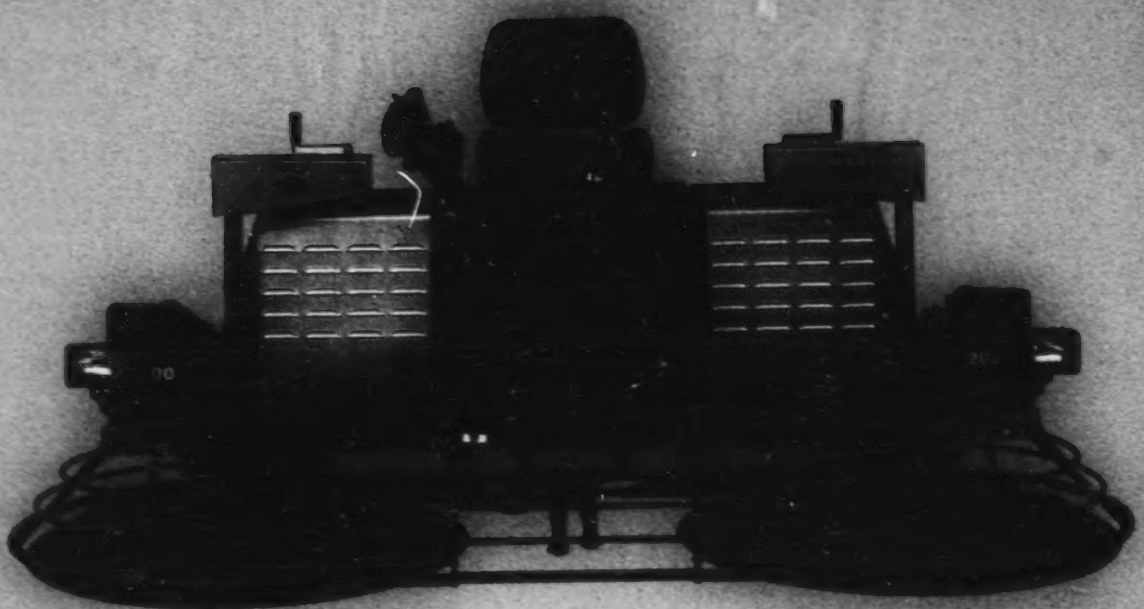
ABSTRACT

The instructor's guide in this package, which is one in a series of new publications developed to replace the Multistate Academic and Vocational Curriculum Consortium's previous small-engine curricula, contains the materials required to teach a competency-based course in repairing construction equipment. The guide begins with an introduction containing the following: notes on using the publication, competency profile, instructional/task analysis, academic and workplace skill classifications and definitions, and list of related academic and workplace skills. The curriculum contains three units of instruction that are devoted to the following: concrete equipment; water pumps and air compressors; and alternators, generators, and welding equipment. Each unit contains some or all of the following: suggested activities, answers to assignment sheets, answers to written test, written test, unit evaluation form, transparency masters, and worksheet masters. All of the unit components focus on measurable and observable learning outcomes. The activities included deal with routine maintenance and specific repairs of the following pieces of equipment: concrete mixers; concrete-compacting and concrete-finishing equipment; centrifugal, rotary, reciprocating, and diaphragm pumps; rotating and reciprocating compressors; generators, bridge rectifiers; and welders. Also included is a student edition of the curriculum that contains the objective, information, assignment, and job sheets for all three units of instruction. (MN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 421 661

Power Product Equipment Technician: Construction Equipment



U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY HAS BEEN GRANTED BY

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2A

Teacher Edition

MAATCC

CM016948

Power Product Equipment Technician:

Construction Equipment

Written by

Robert Hilley, Technical Writer

Project coordinated by

Sue Jones, Curriculum Specialist
Multistate Academic and Vocational Curriculum Consortium, Inc.

Project developed by

The Multistate Academic and Vocational Curriculum Consortium, Inc.

Board of Directors

Sue Ethelbah, Alaska, Chair
Jim Fliehler, Iowa, Vice-Chair
Emmett Eary, Texas, Parliamentarian
Jean McEntire, Arkansas
Ben Clay, Kansas
Mervin Birdwell, Louisiana
Phyllis Miller, Missouri
Chuck Hopkins, Oklahoma
Larry Nelson, South Dakota
Lynne Cohen, Tennessee

Clark R. Harris, Executive Director

99-013308

800061

Cover art courtesy of Allen Engineering Corporation, Paragould, Arkansas.

©1999 by the Multistate Academic and Vocational Curriculum Consortium, Inc.

All rights reserved. No part of this book may be reproduced in any form or by any means without written permission from the publisher.

Printed in the United States of America by the
Oklahoma Department of Vocational-Technical Education
Stillwater, OK 74074-4364

Multistate Academic and Vocational Curriculum Consortium, Inc.
1500 West Seventh Avenue
Stillwater, OK 74074-4364

The Multistate Academic and Vocational Curriculum Consortium (MAVCC) does not discriminate on the basis of race, creed, color, national origin, sex, age, religion, veteran status, or qualified handicap.

Power Product Equipment Technician: Construction Equipment

Teacher Edition

Table of Contents

Foreword	v
Acknowledgments	vii
Use of introductory materials	ix
Use of this publication	xi
Competency profile	xv
Instructional/task analysis	xvii
Academic and workplace skill classifications and definitions	xxi
Related academic and workplace skills list	xxiii

Teacher page

Unit 1: Concrete Equipment

Suggested Activities	1
Answers to Assignment Sheet	9
Answers to Written Test	11
Written Test	13
Unit Evaluation Form	21
Transparency Masters	
1—Major Components of Concrete Mixers	23
2—Major Components of Concrete-Compacting Equipment	25
3—Major Components of Concrete-Finishing Equipment	27
Worksheet Masters	
1—Perform Routine Maintenance on Concrete Mixers	29
2—Repair Concrete Mixers	31
3—Perform Routine Maintenance on Concrete-Compacting Equipment	33
4—Repair Concrete-Compacting Equipment	35
5—Perform Routine Maintenance on Concrete-Finishing Equipment	37
6—Repair Concrete-Finishing Equipment	39

Unit 2: Water Pumps and Air Compressors

Suggested Activities	41
Answers to Assignment Sheet	47
Answers to Written Test	49
Written Test	53
Unit Evaluation Form	61
Transparency Masters	
1—Common Types of Water Pumps: Centrifugal Pump	63
2—Common Types of Water Pumps: Rotary Pump	65
3—Common Types of Water Pumps: Reciprocating Pump	67
4—Common Types of Water Pumps: Diaphragm Pump	69
5—Common Types of Air Compressors: Rotating Compressor	71
6—Common Types of Air Compressors: Reciprocating Compressor	73
Worksheet Masters	
1—Perform Routine Maintenance on Water Pumps	75
2—Repair Water Pumps	77
3—Perform Routine Maintenance on Air Compressors	79
4—Repair Air Compressors	81

Table of Contents

Unit 3: Alternators, Generators, and Welding Equipment

Suggested Activities 83
Answers to Assignment Sheet 91
Answers to Written Test 93
Written Test 97
Unit Evaluation Form 103
Transparency Masters
- 1—Major Components of Generators 105
- 2—Bridge Rectifiers 107
- 3—Major Components of Welders 109

Worksheet Masters
- 1—Perform Routine Maintenance on Alternators and Generators 111
- 2—Repair Alternators and Generators 113
- 3—Perform Routine Maintenance on Welders 115
- 4—Repair Welders 117

Foreword

Power Product Equipment Technician: Construction Equipment is one in a series of new publications developed to replace MAVCC's previous small-engine series.

Three new publications in the new *Power Product Equipment Technician* series have been developed to replace the core publication for MAVCC's previous small-engine series.

- The first publication, *Theory and Principles of Engine Operation*, is divided into two sections: Section A, "Orientation," and Section B, "Basic Engine Theory and Operation." Section A covers basic workplace safety and first aid, common hand tools, common fasteners, and related math and measuring. Section B addresses reference materials, basic engine principles, engine design and identification, engine operation, and parts management, inventory control, and service orders.

- The second publication, *Engine Systems and Service*, is also divided into two sections: Section A, "Engine Systems," and Section B, "Engine Overhaul." Section A covers lubrication systems, cooling systems, fuel systems, governor systems, basic electrical principles, ignition systems, starting systems, charging systems, and exhaust systems. Section B addresses engine overhaul, troubleshooting, and failure analysis.

- *Equipment Systems*, the third publication, consists of seven units that cover principles of power transmission, mechanical drive systems, principles of fluid power, hydraulic and pneumatic drive systems, wheel and brake systems, chassis and steering systems, and chassis electrical systems.

This publication, *Construction Equipment*, is one in a series of spin-off publications that follow the core materials to complete the new *Power Product Equipment Technician* series. *Construction Equipment* contains three units:

- Unit 1: Concrete Equipment (powered concrete mixers, tampers, vibrators, floats, trowels, and screeds)
- Unit 2: Water Pumps and Air Compressors
- Unit 3: Alternators, Generators, and Welding Equipment

Other spin-off publications to be developed for the new series include *Lawn and Garden Equipment* and *Outboard-Engine Systems and Service*.

Lawn and Garden Equipment will contain an introduction to lawn and garden equipment, a unit on light-duty lawn and garden equipment (walk-behind lawn mowers, edgers, trimmers, dethatchers, blowers, hedge clippers, snow blowers, and pressure washers), a unit on heavy-duty lawn and garden equipment (garden tractors, riding lawn mowers, tillers, log splitters, and shredders), and a unit on chain saws.

Outboard-Engine Systems and Service will contain units on the power head, mid-section, and lower unit of outboard engines as well as units on trailers, boat accessories and rigging, and seasonal service.

These new instructional materials reflect the changes that have occurred in the industry as a result of emerging technology and the demand for more highly skilled workers. The growing need for entry-level workers to be able to read and interpret information provided in manufacturers' service manuals has prompted us to include assignment sheets that teach students how to use reference materials and to create job sheets with worksheets that require students to obtain specific information from a related service manual before completing a specific task.

Foreword

Today's workers also need a stronger foundation in theoretical concepts and principles to help them better understand how engine systems and equipment components interrelate, and the information sheets and supplements in the student edition have been designed to help provide that foundation.

The success of this publication is due in large part to the capabilities of the personnel who worked with its development. Appreciation is extended to them for their valuable contributions to the publication.

These instructional materials are designed for student use and to assist teachers in organizing and improving instruction. These instructional materials are based on the curriculum-alignment concept of first stating the objectives (objective sheet), developing instructional strategies for teaching to those objectives (information, assignment, and job sheets), and assessing to those same objectives (written test—a criterion-referenced evaluation instrument).

Every effort has been made to make these materials basic, readable, and by all means, usable. However, as with all of MAVCC's instructional materials, teachers must localize and personalize these materials to meet their community, classroom/laboratory, and individual student's situation. Teachers are encouraged to supplement the instructional materials and to develop strategies for motivating their students.

Special attention should be given to the matrix identifying basic academic skills being reinforced in these instructional materials as well as the suggestions on ways to increase reinforcement of academic and workplace skills. By reinforcing these skills, the instructor should assist students in improving their employability skills.

As you use these instructional materials, we hope that you will find that they contribute to the quality of your program. If any problems occur or if you have any suggestions for improvement of the materials, please call or write us.

Sue Ethelbah, Chair
Board of Directors
Multistate Academic and
Vocational Curriculum Consortium, Inc.

Clark R. Harris
Executive Director
Multistate Academic and
Vocational Curriculum Consortium, Inc.

Acknowledgments

Appreciation is extended to those individuals who contributed their time and talent to the development of *Power Product Equipment Technician: Construction Equipment.*

The contents of this publication were planned and reviewed by the following members of the Multistate Academic and Vocational Curriculum Consortium development committee:

Dave Brown
Marine Repair Instructor
Iowa Lakes Community College
Emmetsburg, Iowa

Pat Day
Kohler Sales and Service
Representative/OEM Specialist
Tulsa, Oklahoma

Doug Hankwitz
Instructor
Kirkwood Community College
Cedar Rapids, Iowa

Mickey Hathaway
Instructor
Canyon High School
Canyon, Texas

James Mansell
Power Product Equipment Instructor
Francis Tuttle Vo-Tech School
Oklahoma City, Oklahoma

Trence McCoy
Instructor
Louisiana Technical College
Shreveport-Bossier Campus
Shreveport, Louisiana

Robert Richter
Director of Service Education
Engine Warehouse Inc.
Norman, Oklahoma

Dean Wimer
Instructor
McMinnville, Oregon

Thanks are extended to Bob Davis, art department manager; Rose Primeaux, word processing supervisor; Danny Darrow, printing plant manager; Karen Hart, electronic/desktop publishing technician; and the other employees of the Graphics Division of the Oklahoma Department of Vocational and Technical Education for artwork, paste-up, phototypesetting, and printing of this text.

Appreciation is also extended to Nancy Hilley for providing the major portion of the artwork used within this publication and to Allen Engineering Corporation, Paragould, Arkansas, for providing the artwork used on the covers of the student and teacher editions of this publication.

Use of Introductory Materials

Introductory materials are included in the teacher edition only and contain useful information to assist administrators and teachers in planning for instruction.

In addition to the general information—such as the table of contents, foreword, and acknowledgments page—information is included on the following:

1. **Use of this publication**—Explains the components of a unit of instruction and how they should be used as part of the teaching/learning process.

2. **Competency profile**—Provides a record of student performance for each task included in a unit of instruction. This profile becomes a part of the student's permanent records and should be utilized when directing the student toward employment opportunities.

3. **Instructional/task analysis**—Provides a quick review of the contents of the publication; identifies cognitive (knowledge) skills and psychomotor (doing) skills addressed in each unit of instruction.

4. **Academic and workplace skill classifications and definitions**—Defines the basic-skill classifications used by MAVCC. Skill areas reflected by skill groups, subskills, and descriptions have been identified using *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want.* These have been adapted by MAVCC.

5. **Related academic and workplace skills list**—Classifies unit tasks (assignment sheets and job sheets) according to related academic and workplace skills being reinforced.

As you use these materials, it is hoped that they will provide useful information to meet a variety of needs.

Use of This Publication

Instructional units

Power Product Equipment Technician: Construction Equipment contains three units of instruction:

- Unit 1: Concrete Equipment
- Unit 2: Water Pumps and Air Compressors
- Unit 3: Alternators, Generators, and Welding Equipment

Each instructional unit in a student edition includes some or all of the following components: objective sheet, information sheet, assignment sheets, and job sheets.

Each section in this teacher edition includes some or all of the following components for each of the three units of instruction: suggested activities, answers to assignment sheets, answers to written test, written test, unit evaluation form, transparency masters, and worksheet masters.

All of the unit components focus on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help to determine the following:

- Amount of materials that can be covered in each class period.
- Skills that must be demonstrated.
- Amount of class time needed for teacher demonstrations.
- Amount of time needed for student practice.
- Supplementary materials, including print and nonprint media and equipment and supplies, that must be ordered.
- Resource people who must be contacted.

Student-edition components

It is a challenge to keep students motivated. Instructors should supplement the student-edition components by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each component can best be taught. Allow students to become involved in preparing and planning their teaching/learning experiences.

Objective sheet. Each unit of instruction is based on performance objectives that state the goals for successful completion of the course. These performance objectives are stated in two forms: unit objectives, which state the expected performance of each student after completion of the unit of instruction, and specific objectives, which state what the student must do to reach the unit objective.

The objectives should be stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Teachers should prepare for each unit by deciding how each objective can best be taught.

Use of This Publication

Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the teacher should remember to supply the needed information-sheet, assignment-sheet, job-sheet, and written-test items.

Information sheet. The information sheet provides the content essential for meeting the cognitive (knowledge) objectives of the unit. Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide information for the teaching of each objective.

Assignment sheets. Assignment sheets provide students with pencil-and-paper activities that give students the opportunity to make practical application of the knowledge in the information sheet. Criteria are provided to objectively evaluate student performance.

Job sheets. Job sheets are an important segment of each unit; they give the instructor direction as to the psychomotor skills to be taught and allow both the student and instructor to check student progress toward the accomplishment of those skills. The worksheet included in each job sheet provides criteria to allow the instructor to objectively evaluate student performance of a particular psychomotor skill. The instructor should discuss the equipment and materials to be used—emphasizing the specific equipment and materials available in the classroom and/or laboratory—and demonstrate the job-sheet procedure before having students practice the psychomotor skill.

Teacher-edition components

Suggested activities. The suggested activities assist teachers during the preparation stage of the teaching/learning process by providing an instructional plan, teaching suggestions, and a list of supplemental resources. Ways to integrate academic and workplace skills have been included in the teaching suggestions, and skill areas have been noted in bold. The teacher should read the suggested activities before teaching a unit and decide how each objective can best be taught. Time should also be allowed to obtain supplemental materials, prepare audiovisual materials, and contact outside resources. Duties of the teacher will vary according to the particular unit.

References used in the development of each unit are listed in the suggested-activities section, along with suggested supplemental resources that may be used to teach the unit. These materials can be used by the teacher to supplement her or his knowledge of the subject area or to help students with particular interests or objectives in the area covered.

Assignment-sheet and written-test answers. Assignment-sheet answers and written-test answers are designed to assist the teacher in evaluating student performances on the assignment sheets and written test.

Written test. This component is a criterion-referenced evaluation of every cognitive objective listed in the information sheet. If the instructor has added, deleted, or modified objectives, appropriate changes should be made on the written test. It is recommended that the test be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of test items from the units covered may be used for final tests at the end of each term if desired. The test is included in the teacher edition only, but duplication is permitted for student use.

Unit evaluation form. This form provides teachers with a record of each student's performance on a unit of instruction. It includes space for assignment-sheet ratings, job-sheet ratings, written-test scores, and teacher comments. The unit evaluation form may also be duplicated for student use.

Transparency masters. Transparency masters are used to direct the students' attention to the topic of discussion. Transparency masters may provide illustrations, charts, schematics, or additional information needed to clarify and reinforce objectives included in the unit of instruction.

Worksheet masters. Worksheet masters provide the instructor with masters for making photocopies of the evaluation criteria used to evaluate student performance of the psychomotor skills (job sheets) included in the student edition.

Competency Profile

Name: _____

Directions: Evaluate the student using one of the optional rating scales below. Write the appropriate number/letters to indicate the degree of competency achieved. The descriptions associated with each of the numbers/letters focus on a level of student performance for each of the tasks listed. The written-test scoreline is provided for optional teacher use. It may not be applicable in all cases.

Optional rating scales

Option A

Rating scale:

4 – **Skilled** – Can perform job with no additional training
3 – **Moderately skilled** – Has performed job during training program; limited additional training may be required.
2 – **Limited skill** – Has performed job during training program; additional training is required to develop skill.
1 – **Unskilled** – Is familiar with process, but is unable to perform job.
0 – **No exposure** – No information or practice provided during training program; complete training is required.
NA – **Non-applicable.**

Option B

Yes – Can perform with no additional training
No – Is unable to perform satisfactorily

Unit 1: Concrete Equipment

_____ 1. Determine concrete-equipment service specifications and parts requirements
_____ 2. Perform routine maintenance on concrete mixers
_____ 3. Repair concrete mixers
_____ 4. Perform routine maintenance on concrete-compacting equipment
_____ 5. Repair concrete-compacting equipment
_____ 6. Perform routine maintenance on concrete-finishing equipment
_____ 7. Repair concrete-finishing equipment
_____ 8. _____

_____Written-test score

Unit 2: Water Pumps and Air Compressors

_____ 1. Determine water-pump and air-compressor service specifications and parts requirements
_____ 2. Perform routine maintenance on water pumps
_____ 3. Repair water pumps
_____ 4. Perform routine maintenance on air compressors
_____ 5. Repair air compressors
_____ 6. _____

_____Written-test score

Competency Profile

Unit 3: Alternators, Generators, and Welding Equipment

_____ 1. Determine alternator, generator, and welding-equipment service specifications and parts requirements
_____ 2. Perform routine maintenance on alternators and generators
_____ 3. Repair alternators and generators
_____ 4. Perform routine maintenance on welders
_____ 5. Repair welders
_____ 6. _____

_____Written-test score

Comments: _____

_____

_____

_____

_____

Evaluator: _____ **Date:** _____

Permission to duplicate this profile is granted.

Instructional/Task Analysis

Related information: What the student should know	Application: What the student should be able to do
Unit 1: Concrete Equipment	
1. Definitions of terms associated with concrete mixing, compacting, and finishing processes	15. Determine concrete-equipment service specifications and parts requirements
2. Descriptions of common types of concrete mixers	16. Perform routine maintenance on concrete mixers
3. Functions of the major components of concrete mixers	17. Repair concrete mixers
4. Principles of operation of common types of concrete mixers	18. Perform routine maintenance on concrete-compacting equipment
5. Typical service procedures required for concrete mixers	19. Repair concrete-compacting equipment
6. Common types of equipment used to compact concrete	20. Perform routine maintenance on concrete-finishing equipment
7. Functions of the major components of concrete-compacting equipment	21. Repair concrete-finishing equipment
8. Principles of operation of common types of concrete-compacting equipment	
9. Typical service procedures required for concrete-compacting equipment	
10. Common types of equipment used to finish concrete	
11. Functions of the major components of concrete-finishing equipment	
12. Principles of operation of common types of concrete-finishing equipment	
13. Typical service procedures required for concrete-finishing equipment	
14. Safety rules for working with concrete equipment	

Related information: What the student should know	Application: What the student should be able to do
Unit 2: Water Pumps and Air Compressors	
1. Functions of the major components of water pumps	10. Determine water-pump and air-compressor service specifications and parts requirements
2. Common types of water pumps	11. Perform routine maintenance on water pumps
3. Principles of operation of common types of water pumps	12. Repair water pumps
4. Typical service procedures required for water pumps	13. Perform routine maintenance on air compressors
5. Functions of the major components of air compressors	14. Repair air compressors
6. Common types of air compressors	
7. Principles of operation of common types of air compressors	
8. Typical service procedures required for air compressors	
9. Safety rules for working with water pumps and air compressors	
Unit 3: Alternators, Generators, and Welding Equipment	
1. Definitions of terms associated with alternators, generators, and welding equipment	
2. Safety rules for working with electrical equipment	
3. Definitions of the types of generators	
4. Functions of the major components of generators	
5. Principles of operation of generators	
6. Ways of classifying generators	
7. Descriptions of types of rectifiers	

Related information: What the student should know	Application: What the student should be able to do
Unit 3: Alternators, Generators, and Welding Equipment (cont.)	
8. Typical service procedures required for alternators and generators	13. Determine alternator, generator, and welding-equipment service specifications and parts requirements
9. Functions of the major components of welders	14. Perform routine maintenance on alternators and generators
10. Types of welders	15. Repair alternators and generators
11. Principles of operation of welders	16. Perform routine maintenance on welders
12. Typical service procedures required for welders	17. Repair welders

Academic and Workplace Skill Classifications and Definitions

Skill group	Subskill	Definition
Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task.
	Writing	Communicating a thought, idea, or fact in written form in a clear, concise manner.
	Arithmetic/ mathematics	Performing basic computations, applying estimating and reasoning skills, and solving practical problems using a variety of mathematical techniques.
	Science	Applying knowledge learned through study and practice that is based on scientific principles, methods, and techniques.
	Listening	Receiving, interpreting, and responding to verbal messages and other cues.
	Speaking	Communicating a thought, idea, or fact verbally in a clear, concise manner.
Thinking skills	Creative thinking	Using imagination to generate new ideas.
	Decision making	Specifying goals and constraints, generating alternatives, considering risks, and evaluating and choosing the best alternative.
	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results.
	Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information.
	Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills.
	Reasoning	Applying a rule or principle underlying the relationship between two or more objects when solving a problem.
Personal-management skills	Responsibility	Exerting a high level of effort towards goal attainment, working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration.
	Self-esteem	Developing self-confidence and maintaining a positive view of self.
	Career awareness, development, and mobility	Assessing self accurately, setting personal goals, establishing and implementing a plan, and monitoring progress.
	Integrity/honesty	Choosing an ethical course of action when faced with making a decision that may break with personal or societal values and recognizing the impact of violating these beliefs and codes on an organization, self, and others.
	Organizational effectiveness	Adapting to the organization's goals, values, culture, and traditional modes of operation.

Academic and Workplace Skill Classifications and Definitions

Skill group	Subskill	Definition
Interpersonal skills	Teamwork	Working cooperatively with others to reach a common goal.
	Coaching	Helping others learn new skills.
	Leadership	Communicating ideas to justify position; accepting responsibility for others; and encouraging, persuading, convincing, or otherwise motivating an individual or group.
	Negotiation	Resolving conflict between two or more individuals through discussion and compromise.
	Customer service	Working and communicating with customers to satisfy their expectations.
	Cultural diversity	Working well with men and women and with a variety of ethnic, social, or educational backgrounds.
Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources or creating it, and evaluating its relevance and accuracy.
	Organization and storage	Organizing, processing, and maintaining written or computerized records and other forms of information in a systematic way.
	Interpretation	Selecting and analyzing information and communicating the results to others.
	Processing	Using computers to acquire, organize, analyze, and communicate information.
Systems	Interrelationships	Knowing how social, organizational, and technological systems work and operate effectively.
	Monitoring	Distinguishing trends, predicting impact of actions on system operations, diagnosing deviations in systems' performance, and correcting malfunctions.
	Modification and design	Making suggestions to modify existing systems to improve products or services, and developing new or alternative systems.
Technology	Selection	Choosing procedures, tools, or equipment including computers and related technologies.
	Application	Demonstrating proper procedures for setting up and operating equipment.
	Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment, including computers and other technologies.
Resources	Time	Selecting relevant, goal-related activities, ranking them in order of importance, allocating time, and understanding, preparing, and following schedules.
	Money	Using or preparing budgets, making forecasts, keeping records, and making adjustments to meet objectives.
	Material and facilities	Acquiring, storing, and using materials and space efficiently.
	Human resources	Assessing skills and distributing work accordingly; evaluating performance and providing feedback.

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 1: Concrete Equipment			
Determine concrete-equipment service specifications and parts requirements (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Information	Interpretation	Selecting and analyzing information and communicating the results to others
Perform routine maintenance on concrete mixers (J.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment

Task	Skill group	Subskill	Description
Unit 1: Concrete Equipment (cont.)			
Repair concrete mixers (J.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Perform routine maintenance on concrete-compacting equipment (J.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently

Task	Skill group	Subskill	Description
		Unit 1: Concrete Equipment (cont.)	
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Repair concrete-compacting equipment (J.S. 4)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Perform routine maintenance on concrete-finishing equipment (J.S. 5)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task

Task	Skill group	Subskill	Description
Unit 1: Concrete Equipment (cont.)			
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Repair concrete-finishing equipment (J.S. 6)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others

Task	Skill group	Subskill	Description
Unit 1: Concrete Equipment (cont.)			
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Unit 2: Water Pumps and Air Compressors			
Determine water-pump and air-compressor service specifications and parts requirements (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Information	Interpretation	Selecting and analyzing information and communicating the results to others
Perform routine maintenance on water pumps (J.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others

Task	Skill group	Subskill	Description
Unit 2: Water Pumps and Air Compressors (cont.)			
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Repair water pumps (J.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Perform routine maintenance on air compressors (J.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results

Task	Skill group	Subskill	Description
Unit 2: Water Pumps and Air Compressors (cont.)			
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Repair air compressors (J.S. 4)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment

Related Academic and Workplace Skills List

Task	Skill group	Subskill	Description
Unit 3: Alternators, Generators, and Welding Equipment			
Determine alternator, generator, and welding-equipment service specifications and parts requirements (A.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Seeing things in the mind's eye	Mentally organizing and processing symbols, pictures, graphs, and other information
		Knowing how to learn	Using efficient learning techniques to acquire and apply new knowledge and skills
	Information	Interpretation	Selecting and analyzing information and communicating the results to others
Perform routine maintenance on alternators and generators (J.S. 1)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Repair alternators and generators (J.S. 2)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task

Task	Skill group	Subskill	Description
Unit 3: Alternators, Generators, and Welding Equipment (cont.)			
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Perform routine maintenance on welders (J.S. 3)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively

Task	Skill group	Subskill	Description
Unit 3: Alternators, Generators, and Welding Equipment (cont.)			
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment
Repair welders (J.S. 4)	Basic skills	Reading	Comprehending written information and analyzing, summarizing, and applying what has been read to a specific task
		Writing	Communicating a fact in written form in a clear, concise manner
	Thinking skills	Problem solving	Recognizing and defining problems, devising and implementing a plan of action, and tracking and evaluating results
	Personal-management skills	Responsibility	Working hard to become excellent at doing tasks by setting high standards, paying attention to details, and displaying a high level of concentration
	Resources	Material and facilities	Acquiring, storing, and using materials and space efficiently
	Information	Acquisition and evaluation	Identifying need for data, obtaining it from existing sources, and evaluating its relevance and accuracy
		Interpretation	Selecting and analyzing information and communicating the results to others
	Systems	Interrelationships	Knowing how technology systems work and operate effectively
	Technology	Selection	Choosing procedures, tools, or equipment
		Application	Demonstrating proper procedures for setting up and operating equipment
		Maintenance and troubleshooting	Preventing, identifying, or solving problems with equipment

Concrete Equipment
Unit 1

Suggested Activities

Instructional plan

Preparation

- Review the unit in the student edition and plan your presentation. Study the specific objectives to determine the order in which you will present the objectives.

  Review the unit introduction and teaching suggestions included in the delivery and application section below, and plan classroom activities. Also note suggestions for media and supplemental materials.

  Plan presentation to take advantage of student learning styles and to accommodate special-needs students.

- Prepare the classroom by displaying posters, equipment, and tools related to concrete equipment.

- Make transparencies from the transparency masters included in the teacher pages of this unit.

- Select teacher components (written test, unit evaluation form) you want to distribute to your students. Copy and prepare these components for distribution.

- Review the job sheets and worksheets in the student edition and locate the worksheet masters included in the teacher pages of this unit. Copy and prepare extra worksheets for distribution to your students.

Delivery and application

Unit introduction

The skill areas appearing in bold-face type in the unit introduction and teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want.* These have been adapted by MAVCC.

- Provide the students with copies of the student materials. You may choose to begin by discussing the objective sheet. Review the unit and specific objectives with the students. Discuss how meeting the unit objective will improve their employability or will increase their value as an employee. Explain how the specific objectives support the unit objective. **(Listening; adapting to the organization's traditional modes of operation; emphasizing personal and career development)**

Teaching suggestions

Objective 1 Match to their correct definitions terms associated with concrete mixing, compacting, and finishing processes.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

Suggested Activities

- Provide examples of the materials and processes included in the terms. Discuss these materials and describe their purposes in the concrete-making process; discuss briefly the tools used in each stage of the process. **(Listening; seeing things in the mind's eye)**

Objective 2 Match common types of concrete mixers to their correct descriptions.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Use the illustrations in the information sheet and other illustrations from different manufacturers to aid your discussion. Display actual equipment to demonstrate each type of concrete mixer. **(Listening; seeing things in the mind's eye)**

Objective 3 State the functions of the major components of concrete mixers. **Objective 4** State the principles of operation of common types of concrete mixers. **Objective 5** List the typical service procedures required for concrete mixers.

- Read and discuss with students the information presented in these sections of the information sheet. Use Transparency 1, "Major Components of Concrete Mixers," to aid your discussion. **(Reading/listening for content)**

- Provide actual examples of various types of concrete mixers and relate the operation of each to the others. Provide an overview of applications and associated service procedures for each type of concrete mixer. **(Listening; reasoning; seeing things in the mind's eye; interpreting and processing information; system interrelationships)**

Objective 6 Label common types of equipment used to compact concrete.

- Read and discuss with students the information presented in this section of the information sheet. Use the illustrations in the information sheet and other illustrations from different manufacturers to aid your discussion. Display actual equipment to demonstrate each type of equipment used to compact concrete. **(Reading/listening for content)**

Objective 7 State the functions of the major components of concrete-compacting equipment. **Objective 8** State the principles of operation of common types of concrete-compacting equipment. **Objective 9** List the typical service procedures required for concrete-compacting equipment.

- Read and discuss with students the information presented in these sections of the information sheet. Use Transparency 2, "Major Components of Concrete-Compacting Equipment," to aid your discussion. **(Reading/listening for content)**

- Provide actual examples of various types of compacting equipment and relate the operation of each to the others. Provide an overview of applications and associated service procedures for each type of compacting equipment. **(Listening; reasoning; seeing things in the mind's eye; interpreting and processing information; system interrelationships)**

Suggested Activities

Objective 10 Label common types of equipment used to finish concrete.

- Read and discuss with students the information presented in this section of the information sheet. Use the illustrations in the information sheet and other illustrations from different manufacturers to aid your discussion. Display actual equipment to demonstrate each type of finishing equipment. **(Reading/listening for content)**

Objective 11 State the functions of the major components of concrete-finishing equipment. **Objective 12** State the principles of operation of common types of concrete-finishing equipment. **Objective 13** List the typical service procedures required for concrete-finishing equipment.

- Read and discuss with students the information presented in these sections of the information sheet. Use Transparency 3, "Major Components of Concrete-Finishing Equipment," to aid your discussion. **(Reading/listening for content)**

- Provide actual examples of various types of finishing equipment and relate the operation of each to the others. Provide an overview of applications and associated service procedures for each type of finishing equipment. **(Listening; reasoning; seeing things in the mind's eye; interpreting and processing information; system interrelationships)**

Objective 14 State safety rules for working with concrete equipment.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Review with students the proper lifting procedures presented in *Power Product Equipment Technician: Theory and Principles of Engine Operation*, and display protective breathing equipment that may be required when working with cement-dust-covered equipment. Then, emphasize safety rules to follow during service procedures—how to level and block equipment, avoid hot components, etc. **(Listening; reasoning; seeing things in the mind's eye)**

Assignment Sheet 1 Determine concrete-equipment service specifications and parts requirements.

- Have students locate Assignment Sheet 1. Read the introduction and directions to the assignment. **(Reading/listening for direction)**

- Make resources available that will allow the students to determine the required information. Tailor the assignment sheet to equipment used in your facility. **(Reading; writing; seeing things in the mind's eye; acquiring, organizing, interpreting, and processing information; system interrelationships)**

- Answer any student questions and have students complete Assignment Sheet 1.

Suggested Activities

Job Sheet 1 Perform routine maintenance on concrete mixers.

- Have students locate Job Sheet 1 and the worksheet associated with the job sheet. Demonstrate the procedures for performing routine maintenance on concrete mixers. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with concrete mixers that require routine maintenance and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 1.

Job Sheet 2 Repair concrete mixers.

- Have students locate Job Sheet 2 and the worksheet associated with the job sheet. Demonstrate the procedures for repairing concrete mixers. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with concrete mixers that require repair and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 2.

Job Sheet 3 Perform routine maintenance on concrete-compacting equipment.

- Have students locate Job Sheet 3 and the worksheet associated with the job sheet. Demonstrate the procedures for performing routine maintenance on concrete-compacting equipment. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with concrete-compacting equipment that requires routine maintenance and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 3.

Job Sheet 4 Repair concrete-compacting equipment.

- Have students locate Job Sheet 4 and the worksheet associated with the job sheet. Demonstrate the procedures for repairing concrete-compacting equipment. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with concrete-compacting equipment that requires repair and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 4.

Suggested Activities

Job Sheet 5 Perform routine maintenance on concrete-finishing equipment.

- Have students locate Job Sheet 5 and the worksheet associated with the job sheet. Demonstrate the procedures for performing routine maintenance on concrete-finishing equipment. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with concrete-finishing equipment that requires routine maintenance and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 5.

Job Sheet 6 Repair concrete-finishing equipment.

- Have students locate Job Sheet 6 and the worksheet associated with the job sheet. Demonstrate the procedures for repairing concrete-finishing equipment. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with concrete-finishing equipment that requires repair and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 6.

Evaluation

- Evaluate the assignment sheet. See the evaluation criteria listed at the top of the assignment sheet as well as the teacher page "Answers to Assignment Sheet."

- Evaluate the job sheets.

  When the student is ready to perform a specific task, obtain a copy of the worksheet associated with each job sheet. Worksheets may be found in the student edition and in the teacher pages following the transparency masters. Then, observe the student performing the procedure.

  After the student has completed the procedure, rate the student using the criteria provided on the worksheet. If the student's performance is unacceptable, have the student review the materials and perform the procedure again for evaluation.

  Two sample performance evaluation keys are provided on the next page. Many other keys are available. Select one evaluation key (grading scale) that best fits your program needs.

Suggested Activities

Performance Evaluation Keys

Sample A

4 — Skilled—Can perform job with no additional training.
3 — Moderately skilled—Has performed job during training program; limited additional training may be required.
2 — Limited skill—Has performed job during training program; additional training is required to develop skill.
1 — Unskilled—Is familiar with process, but is unable to perform job.

Sample B

Yes—Can perform job with no additional training.

No—Is unable to perform job satisfactorily.

- Give the written test. See the teacher page "Written Test."
- Evaluate the written test. See the teacher page "Answers to Written Test."
- Compile written-test, assignment-sheet, and job-sheet scores. See the teacher page "Unit Evaluation Form."
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- Graf, Rudolf F., and George J. Whalen. *VNR Illustrated Guide to Power Tools*. New York: Van Nostrand Reinhold Company, 1978.
- *Outdoor Power Equipment Repair*. Stillwater, Oklahoma: Multistate Academic and Vocational Curriculum Consortium, 1985.
- *Power Tools and Equipment*. Alexandria, Virginia: Time-Life Books, Inc., 1989.
- *Slabs on Grade*. Detroit, Michigan: American Concrete Institute, 1982.
- Taylor, Graham. *Concrete Site Work*. London: Thomas Telford, Limited, 1984.
- Waddell, Joseph J., and Joseph A. Dobrowolski. *Concrete Construction Handbook*, 3rd ed. New York: McGraw-Hill, Inc., 1993.

Suggested supplemental resources

Print media

- *Power Equipment Trade* magazine. Hatton-Brown Publishers, Inc., P O. Box 2268, Montgomery, Alabama 36102.

Suggested Activities

- Service manuals for equipment covered in this unit.
- Parts catalogs for equipment covered in this unit. Available from equipment manufacturers.

Non-print media

- *The Physical World of a Machine.* Tel-A-Train, 309 North Market Street, P.O. Box 4752, Chattanooga, Tennessee 37405, (615) 624-2628.
- *Roller Chain.* Tel-A-Train, 309 North Market Street, P.O. Box 4752, Chattanooga, Tennessee 37405, (615) 624-2628.
- *V-Belt: Proper Care.* Marshall Maintenance Productions, 529 S. Clinton Avenue, Trenton, New Jersey 08611, (800) 257-0430.
- *V-Belts.* Tel-A-Train, 309 North Market Street, P.O. Box 4752, Chattanooga, Tennessee 37405, (615) 624-2628.

Concrete Equipment
Unit 1

Answers to Assignment Sheet

Assignment Sheet 1—Student performance should be evaluated according to the criteria listed on the assignment sheet. The answers will depend upon the equipment selected by the instructor.

Concrete Equipment
Unit 1

Answers to Written Test

1. a. 4
   b. 6
   c. 5
   d. 3
   e. 1
   f. 2

2. a. 2
   b. 3
   c. 1

3. a. Holds the concrete mixture and mixes the ingredients used in making concrete
   b. Provides the power to mix the concrete
   c. Transmits the power from the engine to the tub
   d. Supports the other components of the concrete mixer
   e. Turn to mix the concrete ingredients

4. a. The engine drives a mechanical equipment drive or an equipment drive that is directly geared to the base of the tub. The equipment drive drives a shaft, sprocket, or pulley that transmits power from the engine to the drive gear. The drive gear drives a second gear that is attached to or built into the bottom of the tub. The tub rotates on a rail to mix the concrete.

   b. The engine drives a mechanical equipment drive. The equipment drive rotates the blade shaft, which has two or more blades mounted to it. The blades rotate within the tub to mix the concrete.

   c. The engine drives a mechanical equipment drive. The equipment drive rotates one or more shafts, each of which has two or more blades mounted to it. The blades rotate in the tub to mix the concrete.

5. Answers may appear in any order.

   - Service engine
   - Adjust belt
   - Replace belt
   - Lubricate shafts/gears
   - Clean moving parts

6. a. Tamper
   b. Vibrator

7. a. Provides rotary power
   b. Allows the operator to control the movement of the equipment
   c. Provides the motion used to compact the concrete

Answers to Written Test

8. a. An engine drives an equipment drive that converts the rotary motion from the engine into reciprocating motion that drives a rod. When the rod is inserted into the concrete, the reciprocating motion of the rod compacts the concrete mixture.

   b. An engine is linked to a cable that rotates inside the rod to create low-frequency vibrations. When the rod is inserted into the concrete, the low-frequency vibrations from the rod compact the concrete mixture.

9. Answers may appear in any order.

   - Service engine
   - Lubricate linkages

10. a. Operator-ridden trowel
    b. Disc-type float
    c. Pony trowel
    d. Power screed

11. a. Provides rotary power
    b. Allows the operator to control and guide the finishing equipment
    c. Supports the engine and protects the blades
    d. Move over the concrete to smooth its surface

12. a. The output shaft of the engine is generally mounted directly to the disc or blades. The rotary motion of the engine drives the disc or blades. The rotation of the disc or blades causes the concrete to vibrate so that cement is forced into any voids near the surface.

    b. The output of the engine drives an equipment drive. The equipment drive generally converts the rotary motion of the engine into a reciprocating motion. The reciprocating motion drives a blade or blades that move across the surface of the concrete to compact it and level it, pushing excess concrete ahead of the screed as it moves across the concrete.

13. Answers may appear in any order.

   - Service engine
   - Lubricate blade shaft
   - Maintain fasteners
   - Replace blades

14. a. Concrete equipment is often very heavy; follow proper lifting procedures and remember that this equipment may be too heavy for one person to lift or carry.

    b. Level and properly block concrete mixers before operating.

    c. Do not touch hot engines or friction-heated parts of concrete equipment.

    d. Wear protective breathing equipment as necessary when working with concrete equipment.

Concrete Equipment
Unit 1

Written Test

Name _____ Score _____

1. Match to their correct definitions terms associated with concrete mixing, compacting, and finishing processes. Write the numbers on the blanks provided.

_____ a.	Layer of concrete 4 to 6 inches thick laid upon a bed of sand that is often reinforced with steel mesh	1. Cement
_____ b.	To screed, trowel, or float the surface of the concrete to level the concrete in the form, to remove voids at or near the surface of the mixture, and to obtain a desired surface texture	2. Concrete
_____ c.	To tamp and vibrate poured concrete to remove voids from the mixture created during mixing and pouring	3. Form
_____ d.	Structure built to provide the shape of the concrete poured into it	4. Slab
_____ e.	Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized; an ingredient in concrete	5. Compact
_____ f.	Building material made by mixing cement, sand and aggregates, admixtures, and water	6. Finish

2. Match common types of concrete mixers to their correct descriptions. Write the numbers on the blanks provided.

_____ a.	Concrete mixer with a flat, circular tub with a central shaft to which blades are attached; the shaft rotates to move the blades through the concrete mixture	1. Drum
_____ b.	Concrete mixer with a flat, rectangular tub with at least two shafts to which paddles are attached; the shafts rotate to move the paddles through the concrete mixture	2. Pan
_____ c.	Concrete mixer with an elongated, circular tub with fixed blades attached to the sides of the tub; the tub rotates to move the concrete mixture over the blades	3. Paddle

3. State the functions of the major components of concrete mixers. Write your answers on the blanks provided beside the terms below.

   a. Tub _____

   b. Engine _____

   c. Equipment drive _____

   d. Frame _____

   e. Blades _____

4. State the principles of operation of common types of concrete mixers. Write your answers on the blanks provided beside the terms below.

   a. Drum mixers _____

   b. Pan mixers _____

c. Paddle mixers _____

_____

_____

_____

_____

_____

_____

_____

5. List the typical service procedures required for concrete mixers. Write your answers on the blanks provided below.

   a. _____

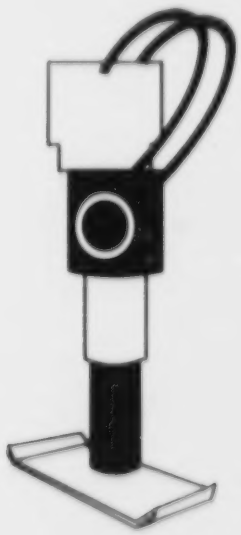
   b. _____

   c. _____

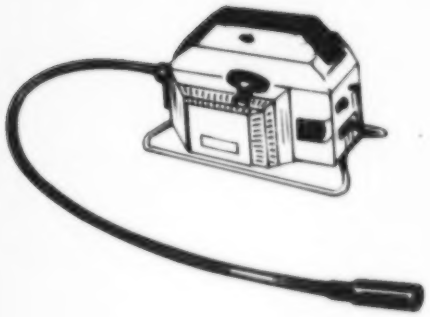
   d. _____

   e. _____

6. Label common types of equipment used to compact concrete. Write your answers on the blanks provided under the illustrations below and on the next page.



a. _____



b. _____

7. State the functions of the major components of concrete-compacting equipment. Write your answers on the blanks provided beside the terms below.

   a. Engine _____

   _____

   b. Handle(s) _____

   _____

   c. Rod _____

   _____

8. State the principles of operation of common types of concrete-compacting equipment. Write your answers on the blanks provided beside the terms below.

   a. Tampers _____

   _____

   _____

   _____

   _____

   b. Vibrators _____

   _____

   _____

   _____

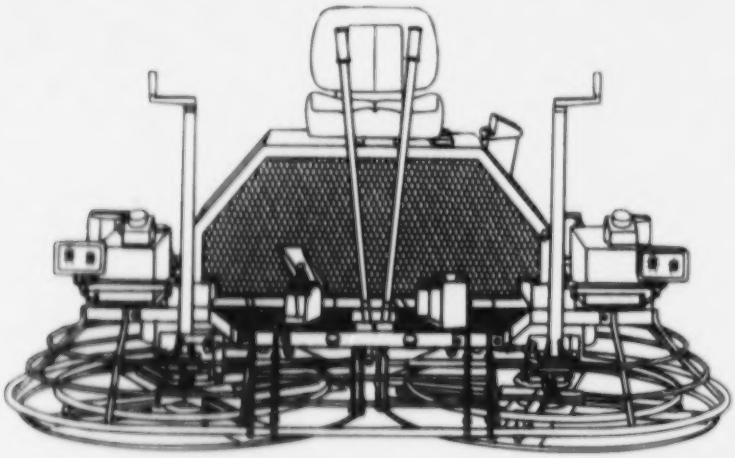
   _____

9. List the typical service procedures required for concrete-compacting equipment. Write your answers on the blanks provided below.

   a. _____

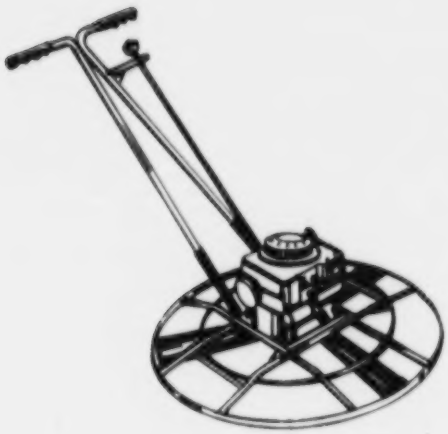
   b. _____

10. Label common types of equipment used to finish concrete. Write your answers on the blanks provided under each of the illustrations below and on the next page.

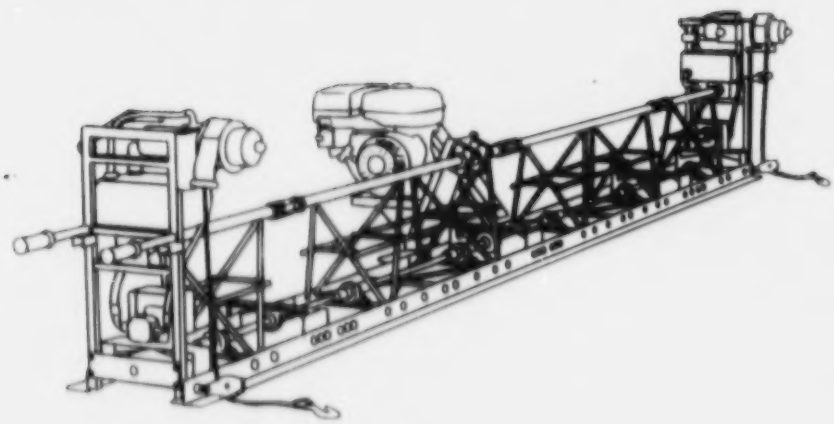


a. _____

b. _____



c. _____



d. _____

11. State the functions of the major components of concrete-finishing equipment. Write your answers on the blanks provided beside the terms below.

a. Engine _____

_____

b. Handle _____

_____

c. Deck _____

_____

d. Blades _____

_____

12. State the principles of operation of common types of concrete-finishing equipment. Write your answers on the blanks provided beside the terms below.

    a. Floats and trowels _____

    b. Screeds _____

13. List the typical service procedures required for concrete-finishing equipment. Write your answers on the blanks provided below.

    a. _____

    b. _____

    c. _____

    d. _____

14. State safety rules for working with concrete equipment. Write the complete safety rule on the blanks provided beside the terms below and on the next page.

    a. Lifting procedures _____

    b. Leveling mixers _____

    c. Friction-heated parts _____

d. **Breathing equipment** _____

_____

_____

Permission to duplicate this test is granted.

Concrete Equipment
Unit 1

Unit Evaluation Form

Student name _____ Unit rating _____

Assignment-sheet rating

Assignment Sheet 1—Determine Concrete-Equipment Service Specifications and Parts Requirements Rating _____

Comments: _____

_____

Job-sheet ratings

Job Sheet 1—Perform Routine Maintenance on Concrete Mixers Rating _____

Comments: _____

_____

Job Sheet 2—Repair Concrete Mixers Rating _____

Comments: _____

_____

Job Sheet 3—Perform Routine Maintenance on Concrete-Compacting Equipment Rating _____

Comments: _____

_____

Job Sheet 4—Repair Concrete-Compacting Equipment Rating _____

Comments: _____

_____

Job Sheet 5—Perform Routine Maintenance on Concrete-Finishing Equipment Rating _____

Comments: _____

_____

Unit Evaluation Form

Job Sheet 6—Repair Concrete-Finishing Equipment Rating _____

Comments: _____

_____

Written-test scores

Pretest _____ Posttest _____ Other _____

Comments: _____

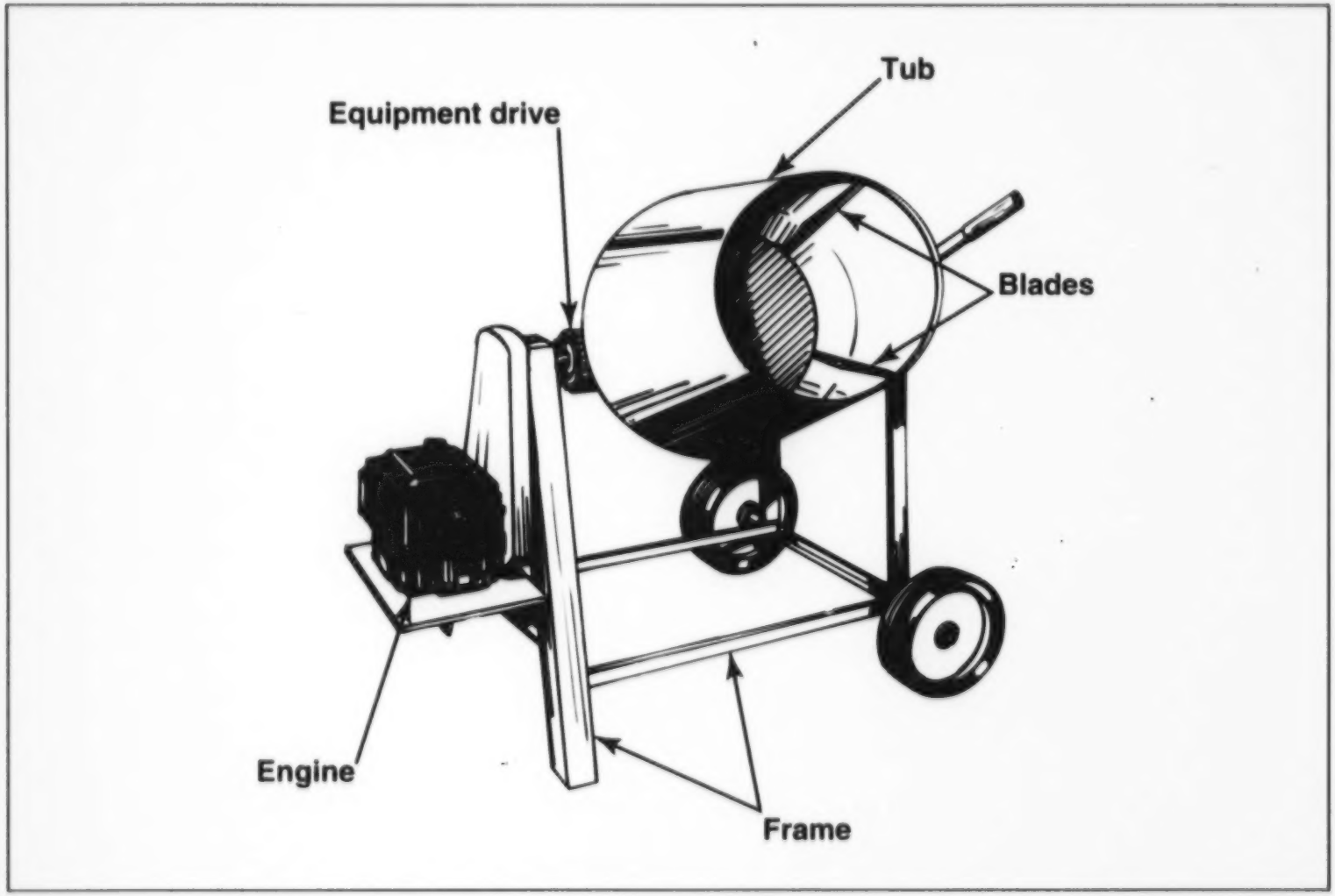
_____

Teacher signature _____ Date _____

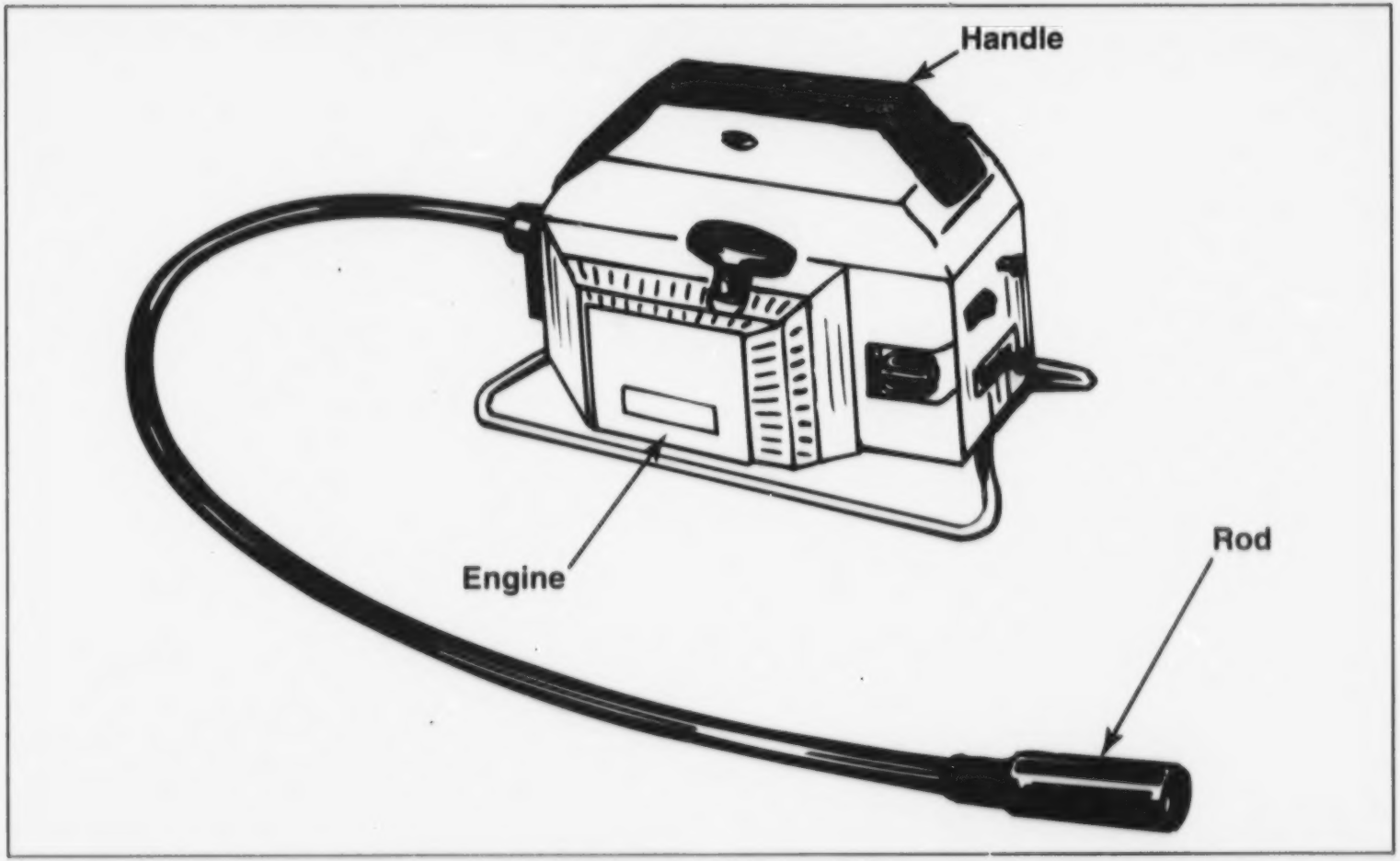
Student signature _____ Date _____

Permission to duplicate this form is granted.

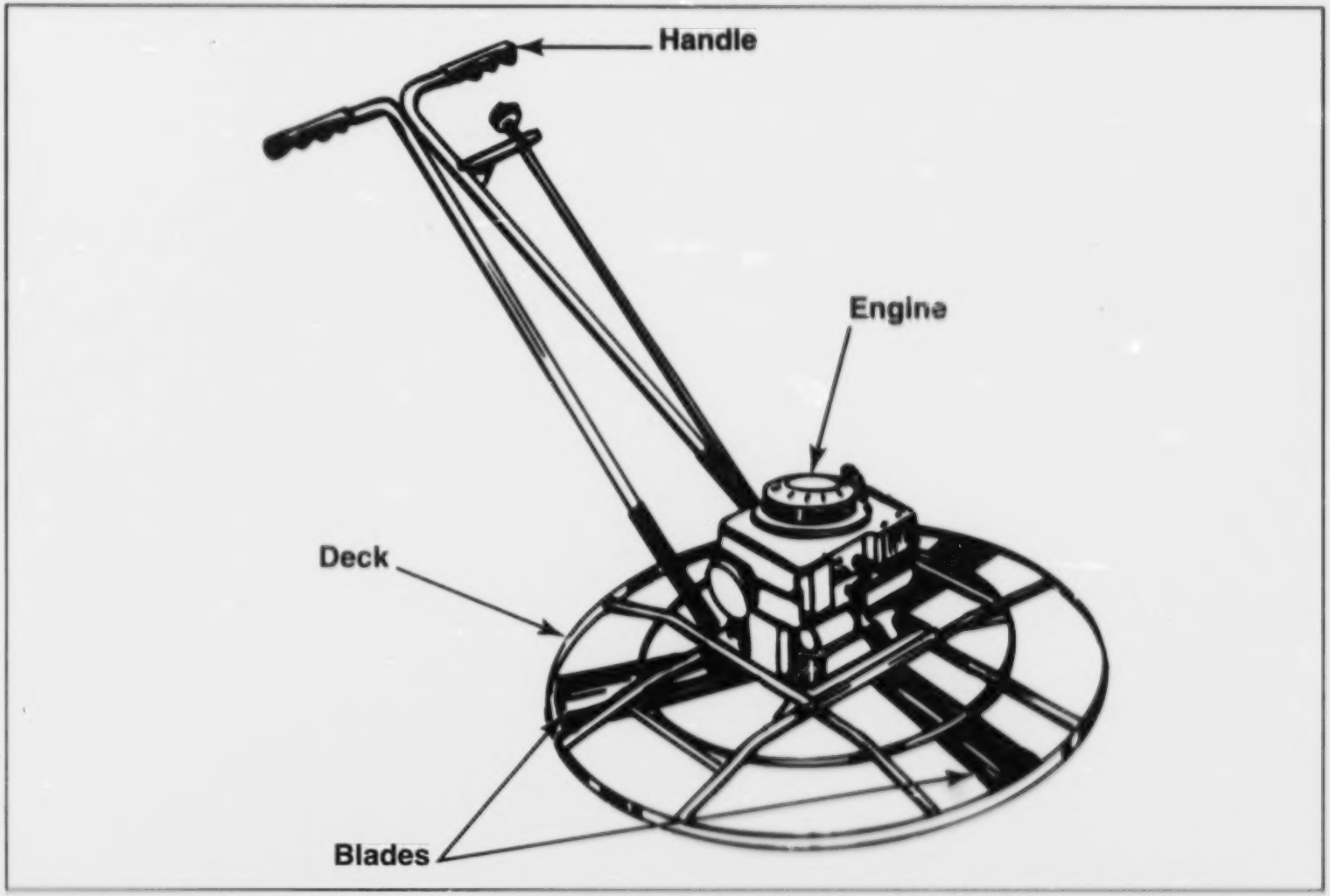
Major Components of Concrete Mixers



Major Components of Concrete-Compacting Equipment



Major Components of Concrete-Finishing Equipment



Job Sheet 1

Worksheet—Perform Routine Maintenance on Concrete Mixers

Name _____ _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Worksheet—Perform Routine Maintenance on Concrete Mixers

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 2

Worksheet—Repair Concrete Mixers

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 2

Worksheet—Repair Concrete Mixers

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Concrete-Compacting Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Concrete-Compacting Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 4

Worksheet—Repair Concrete-Compacting Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 4

Worksheet—Repair Concrete-Compacting Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	
Procedures completed correctly.	
Proper tools used correctly.	
Safety precautions observed.	
Service meets specifications.	
Clean-up and follow-up actions adequate.	
Overall rating	

Evaluator's comments _____

_____

_____

Job Sheet 5

Worksheet—Perform Routine Maintenance on Concrete-Finishing Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 5

Worksheet—Perform Routine Maintenance on Concrete-Finishing Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 6

Worksheet—Repair Concrete-Finishing Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 6

Worksheet—Repair Concrete-Finishing Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Water Pumps and Air Compressors
Unit 2

Suggested Activities

Instructional plan

Preparation

- Review the unit in the student edition and plan your presentation. Study the specific objectives to determine the order in which you will present the objectives.

  Review the unit introduction and teaching suggestions included in the delivery and application section below, and plan classroom activities. Also note suggestions for media and supplemental materials.

  Plan presentation to take advantage of student learning styles and to accommodate special-needs students.

- Prepare the classroom by displaying posters, equipment, and tools related to air compressors and water pumps.

- Make transparencies from the transparency masters included in the teacher pages of this unit.

- Select teacher components (written test, unit evaluation form) you want to distribute to your students. Copy and prepare these components for distribution.

- Review the job sheets and worksheets in the student edition and locate the worksheet masters included in the teacher pages of this unit. Copy and prepare extra worksheets for distribution to your students.

Delivery and application

Unit introduction

The skill areas appearing in bold-face type in the unit introduction and teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want*. These have been adapted by MAVCC.

- Provide the students with copies of the student materials. You may choose to begin by discussing the objective sheet. Review the unit and specific objectives with the students. Discuss how meeting the unit objective will improve their employability or will increase their value as an employee. Explain how the specific objectives support the unit objective. **(Listening; adapting to the organization's traditional modes of operation; emphasizing personal and career development)**

Suggested Activities

Teaching suggestions

Objective 1 State the functions of the major components of water pumps.
Objective 2 Label common types of water pumps.

- Read and discuss with students the information presented in these sections of the information sheet. **(Reading/listening for content)**

- Use the illustrations in the information sheet and other illustrations from manufacturers to aid your discussion. Display actual equipment to demonstrate each type of water pump. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 3 State the principles of operation of common types of water pumps. **Objective 4** List typical service procedures required for water pumps.

- Read and discuss with students the information presented in these sections of the information sheet. Use Transparencies 1 through 4 to aid your discussion. **(Reading/listening for content)**

- Provide actual examples of the various types of water pumps; relate the operation of each to the others. Provide an overview of applications and associated service procedures for each type of water pump. **(Listening; reasoning; seeing things in the mind's eye; interpreting and processing information; system interrelationships)**

Objective 5 State the functions of the major components of air compressors. **Objective 6** Label common types of air compressors.

- Read and discuss with students the information presented in these sections of the information sheet. **(Reading/listening for content)**

- Use the illustrations in the information sheet and other illustrations from manufacturers to aid your discussion. Display actual equipment to demonstrate each type of air compressor. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 7 State the principles of operation of common types of air compressors. **Objective 8** List typical service procedures required for air compressors.

- Read and discuss with students the information presented in these sections of the information sheet. Use Transparencies 5 and 6 to aid your discussion. **(Reading/listening for content)**

- Provide actual examples of the various types of air compressors; relate the operation of each to the others. Provide an overview of applications and associated service procedures for each type of air compressor. **(Listening; reasoning; seeing things in the mind's eye; interpreting and processing information; system interrelationships)**

Suggested Activities

Objective 9 State safety rules for working with water pumps and air compressors.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Review with students the general safety rules presented in *Power Product Equipment Technician: Theory and Principles of Engine Operation.* Cover MSDS sheets that may apply to the flammable or toxic materials students may contact. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Assignment Sheet 1 Determine water-pump and air-compressor service specifications and parts requirements.

- Have students locate Assignment Sheet 1. Read the introduction and directions to the assignment. **(Reading/listening for direction)**

- Make resources available that will allow the students to determine the required information. Tailor the assignment sheet to equipment used in your facility. **(Reading; writing; seeing things in the mind's eye; acquiring, organizing, interpreting, and processing information; system interrelationships)**

- Answer any student questions and have students complete Assignment Sheet 1.

Job Sheet 1 Perform routine maintenance on water pumps.

- Have students locate Job Sheet 1 and the worksheet associated with the job sheet. Demonstrate the procedures for performing routine maintenance on water pumps. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with water pumps that require routine maintenance and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 1.

Job Sheet 2 Repair water pumps.

- Have students locate Job Sheet 2 and the worksheet associated with the job sheet. Demonstrate the procedures for repairing water pumps. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with water pumps that require repair and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 2.

Suggested Activities

Job Sheet 3 Perform routine maintenance on air compressors.

- Have students locate Job Sheet 3 and the worksheet associated with the job sheet. Demonstrate the procedures for performing routine maintenance on air compressors. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with air compressors that require routine maintenance and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 3.

Job Sheet 4 Repair air compressors.

- Have students locate Job Sheet 4 and the worksheet associated with the job sheet. Demonstrate the procedures for repairing air compressors. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with air compressors that require repair and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 4.

Evaluation

- Evaluate the assignment sheet. See the evaluation criteria listed at the top of the assignment sheet as well as the teacher page "Answers to Assignment Sheet."

- Evaluate the job sheets.

  When the student is ready to perform a specific task, obtain a copy of the worksheet associated with each job sheet. Worksheets may be found in the student edition and in the teacher pages following the transparency masters. Then, observe the student performing the procedure.

  After the student has completed the procedure, rate the student using the criteria provided on the worksheet. If the student's performance is unacceptable, have the student review the materials and perform the procedure again for evaluation.

  Two sample performance evaluation keys are provided on the next page. Many other keys are available. Select one evaluation key (grading scale) that best fits your program needs.

Suggested Activities

Performance Evaluation Keys

Sample A

4 — Skilled—Can perform job with no additional training.
3 — Moderately skilled—Has performed job during training program; limited additional training may be required.
2 — Limited skill—Has performed job during training program; additional training is required to develop skill.
1 — Unskilled—Is familiar with process, but is unable to perform job.

Sample B

Yes—Can perform job with no additional training.

No—Is unable to perform job satisfactorily.

- Give the written test. See the teacher page "Written Test."
- Evaluate the written test. See the teacher page "Answers to Written Test."
- Compile written-test, assignment-sheet, and job-sheet scores. See the teacher page "Unit Evaluation Form."
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- Graf, Rudolf F., and George J. Whalen. *VNR Illustrated Guide to Power Tools.* New York: Van Nostrand Reinhold Company, 1978.
- Hedges, Charles S. *Industrial Fluid Power,* 3rd ed. Dallas, Texas: Womack Educational Publications, 1984.
- *Outdoor Power Equipment Repair.* Stillwater, Oklahoma: Multistate Academic and Vocational Curriculum Consortium, 1985.
- *Power Tools and Equipment.* Alexandria, Virginia: Time-Life Books, Inc., 1989.
- Stewart, Harry L. *Hydraulics for Off-the-Road Equipment.* Indianapolis, Indiana: Theodore Audel and Co., 1978.

Suggested supplemental resources

Print media

- *Power Equipment Trade* magazine. Hatton-Brown Publishers, Inc., P O. Box 2268, Montgomery, Alabama 36102.
- Service manuals for equipment covered in this unit.

Suggested Activities

- Parts catalogs for equipment covered in this unit. Available from equipment manufacturers.

Non-print media

- *Air Compressors*. NUS Training Corporation, 910 Clopper Road, Gaithersburg, Maryland 20878-1399, (800) 848-1717.

  Note: This is a three-part series totaling 180 minutes that covers various types of compressors, including rotary and centrifugal compressors, and their principles of operation.

- *Compressors*. Tel-A-Train, 309 North Market Street, P.O. Box 4752, Chattanooga, Tennessee 37405, (615) 624-2628.

  Note: This 28-minute program introduces types of compressors and describes how they work.

- *The Physical World of a Machine*. Tel-A-Train, 309 North Market Street, P.O. Box 4752, Chattanooga, Tennessee 37405, (615) 624-2628.

Water Pumps and Air Compressors
Unit 2

Answers to Assignment Sheet

Assignment Sheet 1—Student performance should be evaluated according to the criteria listed on the assignment sheet. The answers will depend upon the equipment selected by the instructor.

Water Pumps and Air Compressors
Unit 2

Answers to Written Test

1. a. Provides the rotary power to turn the engine-output shaft
   b. Transmits the rotary power from the engine to the pump impeller
   c. Houses the pump
   d. Moves water through the pump
   e. Allows water to enter the casing
   f. Allows water to exit the casing

2. a. Diaphragm pump
   b. Reciprocating pump
   c. Centrifugal pump
   d. Rotary pump

3. a. **Centrifugal water pump**

   - Rotary motion from the engine turns the engine-output shaft that runs through the center of the pump body; an impeller mounted to the shaft rotates as the shaft turns.
   - The rotating impeller creates low pressure behind the impeller blades; the low pressure draws water into the pump body through a water-inlet port near the shaft.
   - Centrifugal force causes the water to move toward the outside edges of the rotating impeller; the impeller blades push the water through the water-outlet port.

   b. **Rotary water pump**

   - Rotary motion from the engine turns an engine-output shaft that runs through the pump body at a point that is offset from the center of the pump body; a wheel that has either gear teeth or vanes that extend and retract turns within the pump body.
   - Water enters the pump body through the water-inlet port; the rotating wheel moves the water from the water-inlet port to the smaller area of the pump body that is created by the offset position of the engine-output shaft, increasing the pressure on the water and the velocity of the water's movement.
   - The wheel's gear teeth or vanes sweep the water toward the water-outlet port.

   c. **Reciprocating water pump**

   - Rotary motion from the engine is converted to reciprocating motion; the reciprocating motion is transmitted to a rod that is connected to a piston.
   - The up stroke of the piston forces air out of the cylinder, and the resulting low pressure within the cylinder draws water into the cylinder through the water-inlet port and valve.

- The down stroke of the piston closes the water-inlet port and valve, trapping the water in the cylinder below the piston and increasing the water pressure there; the increased pressure opens the water-outlet valve in the piston, which allows water to flow into the cylinder above the piston.

- The next up stroke of the piston forces the water trapped above the piston through the water-outlet port and draws water into the bottom of the cylinder.

d. **Diaphragm water pump**

- A reciprocating shaft driven by the engine pulls the diaphragm away from the pump chamber, creating a larger volume and lower pressure in the chamber.

- Fluid at higher pressure forces its way into the pump chamber past the inlet valve.

- The reciprocating shaft pushes the diaphragm toward the pump chamber, decreasing the volume of the chamber and increasing the pressure.

- The increased pressure and smaller volume force fluid past the outlet valve.

4. Answer should include any five of the following.

- Service engine
- Adjust mechanical linkages
- Lubricate moving parts
- Replace worn or broken parts
- Replace seals
- Clean or replace filters or screens
- Test output

5. a. Provides the rotary power to turn the engine-output shaft
   b. Transmits the rotary power from the engine to the compressor
   c. Allows outside air to enter the compressor
   d. Removes dirt and contaminants from the intake air
   e. Houses the crankshaft, piston assembly, and cylinder
   f. Encloses the cylinder and houses the valves
   g. Allows air to enter the cylinder
   h. Allows compressed air to exit the cylinder
   i. Stores the compressed air
   j. Displays the pressure of the compressed air stored in the reservoir
   k. Releases excess pressure
   l. Diverts compressed air from the reservoir when the desired relief pressure is reached

6. a. Reciprocating compressor
   b. Rotating compressor

7. a. **Rotating air compressor**

   - Rotary motion from the engine turns the engine-output shaft that passes through the compressor body; an impeller mounted to the engine-output shaft rotates as the shaft turns.
   - The rotating impeller draws air into the compressor body through an air-inlet valve near the axis of the impeller.
   - Centrifugal force causes the air to move toward the edges of the rotating impeller; the impeller forces the air through the air-outlet valve and into the reservoir.

   b. **Reciprocating air compressor**

   - Rotary motion from the engine is converted to reciprocating motion; the reciprocating motion is transmitted to a rod that is connected to a piston.
   - The up stroke of the piston produces low pressure within the cylinder, and the resulting low pressure within the cylinder draws air into the cylinder through the one-way check valve in the air-inlet valve.
   - The down stroke of the piston compresses the air inside the cylinder and increases the air pressure; the increased air pressure forces the air-inlet valve to close but opens the one-way check valve in the air-outlet valve, which allows the air under pressure to exit the cylinder and enter the reservoir.
   - The next up stroke of the piston closes the air-outlet valve and opens the air-inlet valve, again creating low pressure in the cylinder.

8. Answer should include any five of the following.

   - Service engine
   - Adjust mechanical linkages
   - Lubricate moving parts
   - Replace worn or broken parts
   - Replace seals
   - Clean or replace filters or screens
   - Test unloader valve
   - Drain water from the tank

9. a. Do not touch hot engines or friction-heated parts of water pumps and air compressors.

   b. Be aware of high-pressure hazards from water pumps and air compressors, especially with hoses and connections.

   c. Observe safety precautions for the flammable or toxic materials used in construction operations.

Water Pumps and Air Compressors
Unit 2

Written Test

Name _____ Score _____

1. State the functions of the major components of water pumps. Write your answers on the blanks provided beside the terms below.

   a. Engine _____

   _____

   b. Engine-output shaft _____

   _____

   c. Casing _____

   _____

   d. Impeller _____

   _____

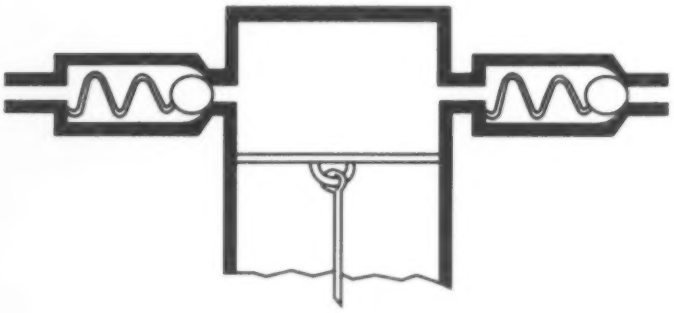
   e. Water-inlet port _____

   _____

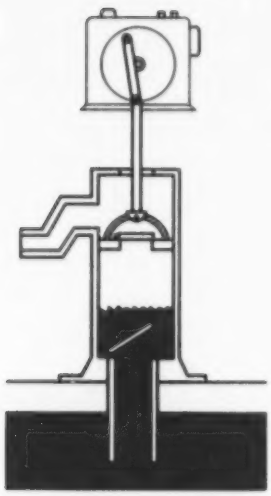
   f. Water-outlet port _____

   _____

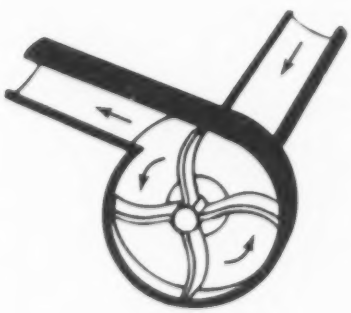
2. Label common types of water pumps. Write your answers on the blanks provided under each of the illustrations below and on the next page.



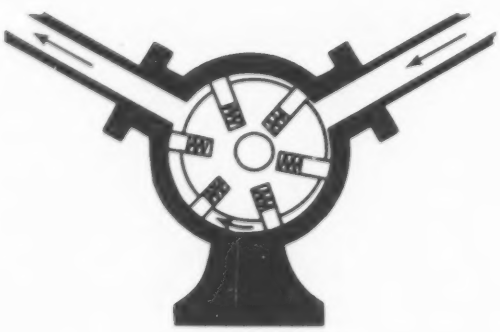
   a. _____



b. _____



c. _____



d. _____

Written Test

3. State the principles of operation of common types of water pumps. Write your answers on the blanks provided beside each of the terms below.

   a. Centrifugal water pump _____

   b. Rotary water pump _____

   c. Reciprocating water pump _____

d. Diaphragm water pump _____

4. List five of the typical service procedures required for water pumps. Write your answers on the blanks provided.

a. _____

b. _____

c. _____

d. _____

e. _____

5. State the functions of the major components of air compressors. Write your answers on the blanks provided beside the terms below and on the next page.

a. Engine _____

b. Engine-output shaft _____

c. Air intake _____

d. Filter _____

e. Block _____

f. Head _____

_____

g. Air-inlet valve _____

_____

h. Air-outlet valve _____

_____

i. Reservoir _____

_____

j. Pressure gauge _____

_____

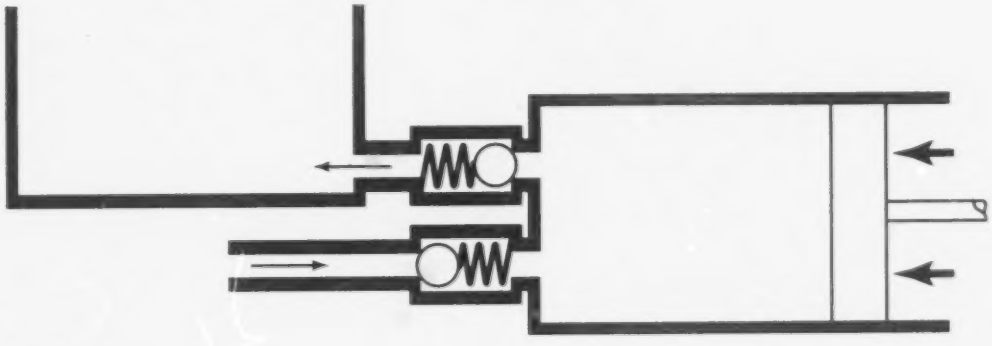
k. Relief valve _____

_____

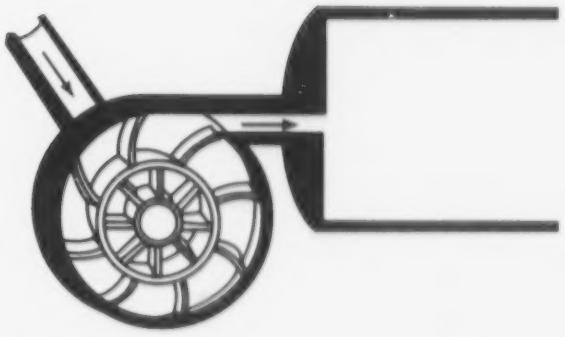
l. Unloader valve _____

_____

6. Label common types of air compressors. Write your answers on the blanks provided under each of the illustrations below and on the next page.



a. _____



b. _____

7. State the principles of operation of common types of air compressors. Write your answers on the blank lines provided beside each of the terms below.

   a. Rotating air compressor _____

   b. Reciprocating air compressor _____

8. List five of the typical service procedures required for air compressors. Write your answers on the blanks provided below.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

9. State safety rules for working with water pumps and air compressors. Write the complete safety rule on the blanks provided beside each of the terms below.

   a. Hot engines or friction-heated parts _____

   _____

   _____

   b. High-pressure hazards _____

   _____

   _____

   c. Flammable or toxic materials _____

   _____

   _____

Permission to duplicate this test is granted.

Water Pumps and Air Compressors
Unit 2

Unit Evaluation Form

Student name _____ Unit rating _____

Assignment-sheet rating

Assignment Sheet 1—Determine Water-Pump and Air-Compressor Service Specifications and Parts Requirements Rating _____

Comments: _____

_____

_____

Job-sheet ratings

Job Sheet 1—Perform Routine Maintenance on Water Pumps Rating _____

Comments: _____

_____

_____

Job Sheet 2—Repair Water Pumps Rating _____

Comments: _____

_____

_____

Job Sheet 3—Perform Routine Maintenance on Air Compressors Rating _____

Comments: _____

_____

_____

Job Sheet 4—Repair Air Compressors Rating _____

Comments: _____

_____

_____

81

Unit Evaluation Form

Written-test scores

Pretest _____ Posttest _____ Other _____

Comments: _____

_____

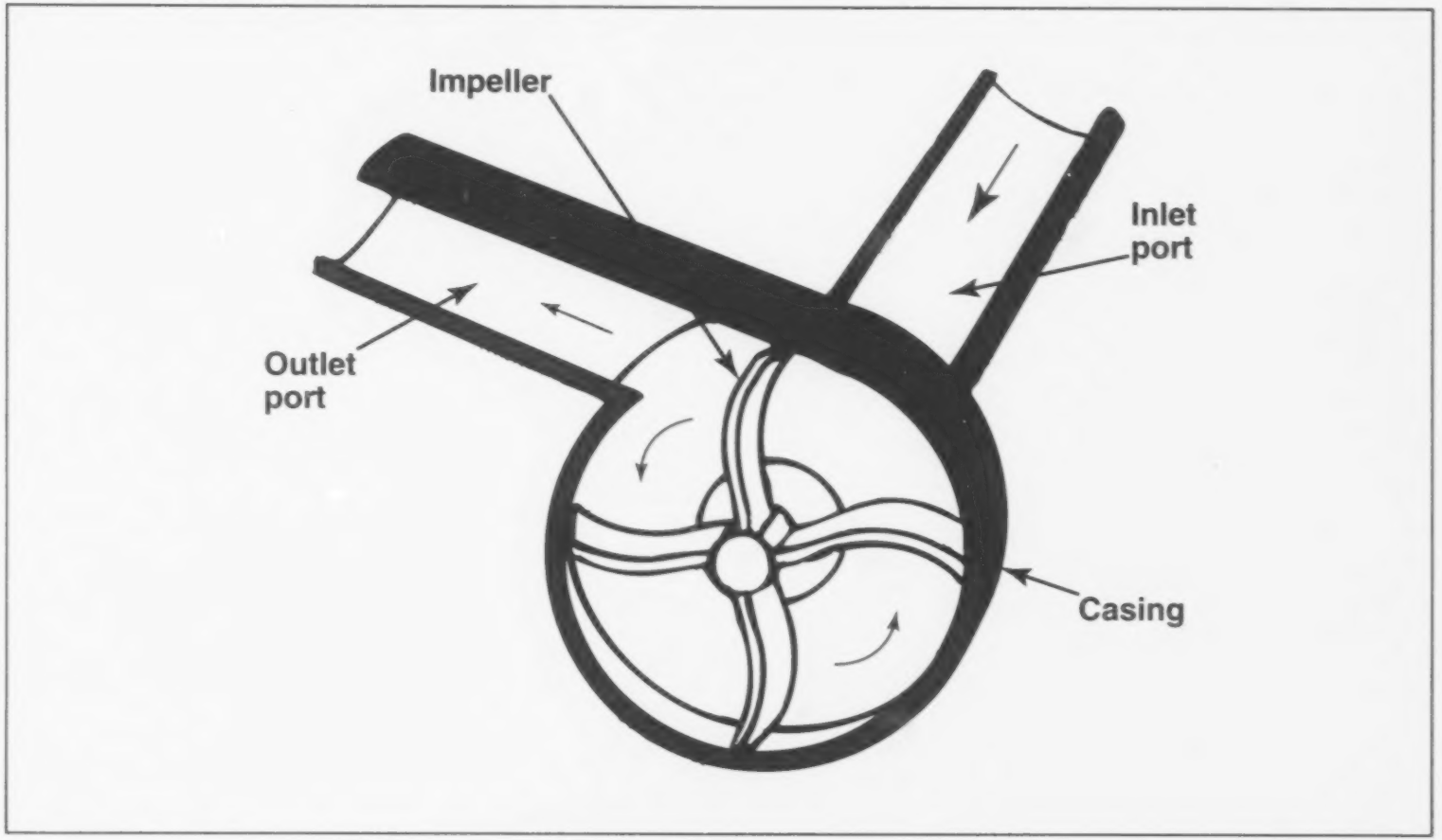
Teacher signature _____ Date _____

Student signature _____ Date _____

Permission to duplicate this form is granted.

Common Types of Water Pumps:

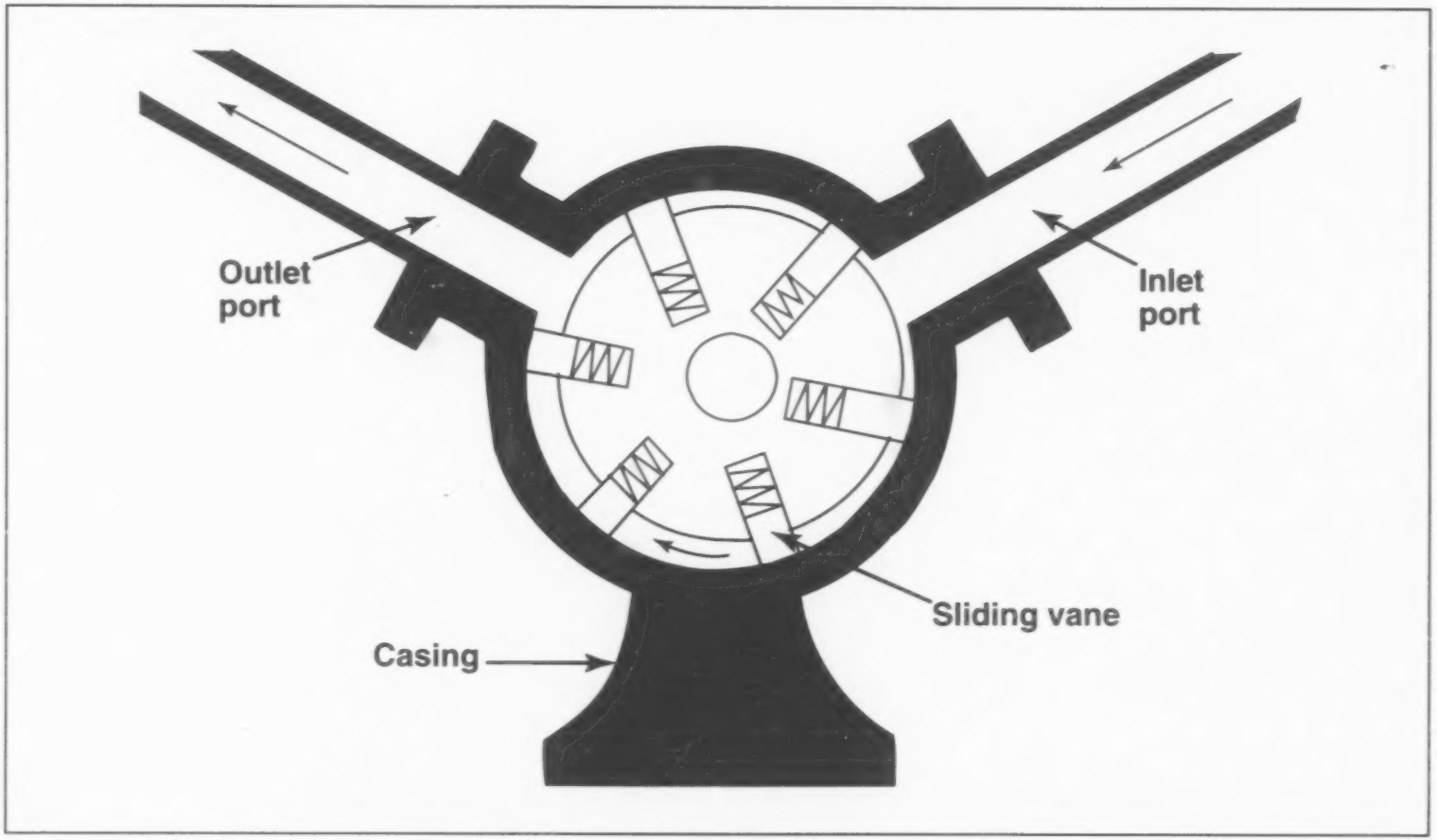
Centrifugal Pump



63

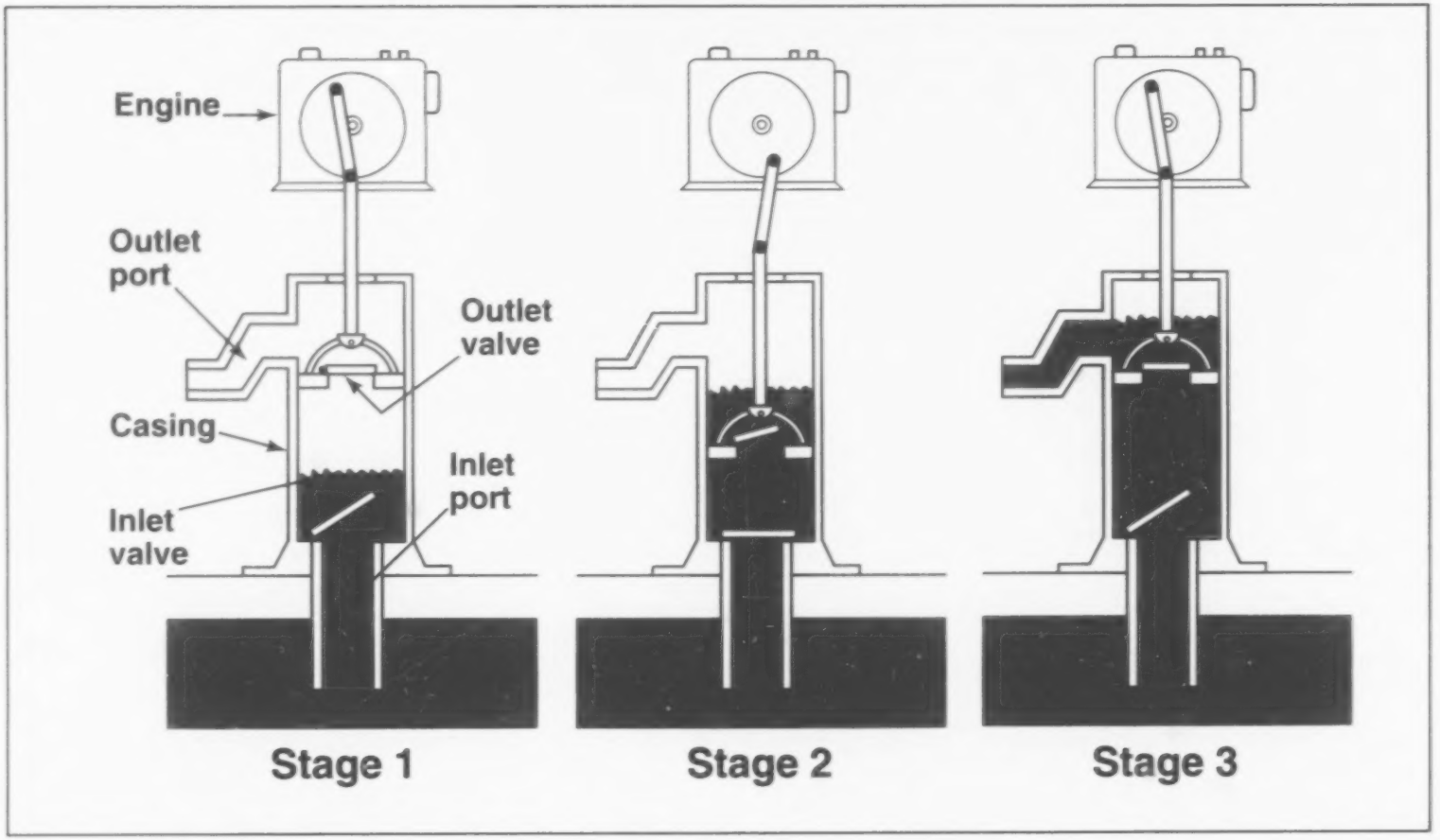
Common Types of Water Pumps:

Rotary Pump



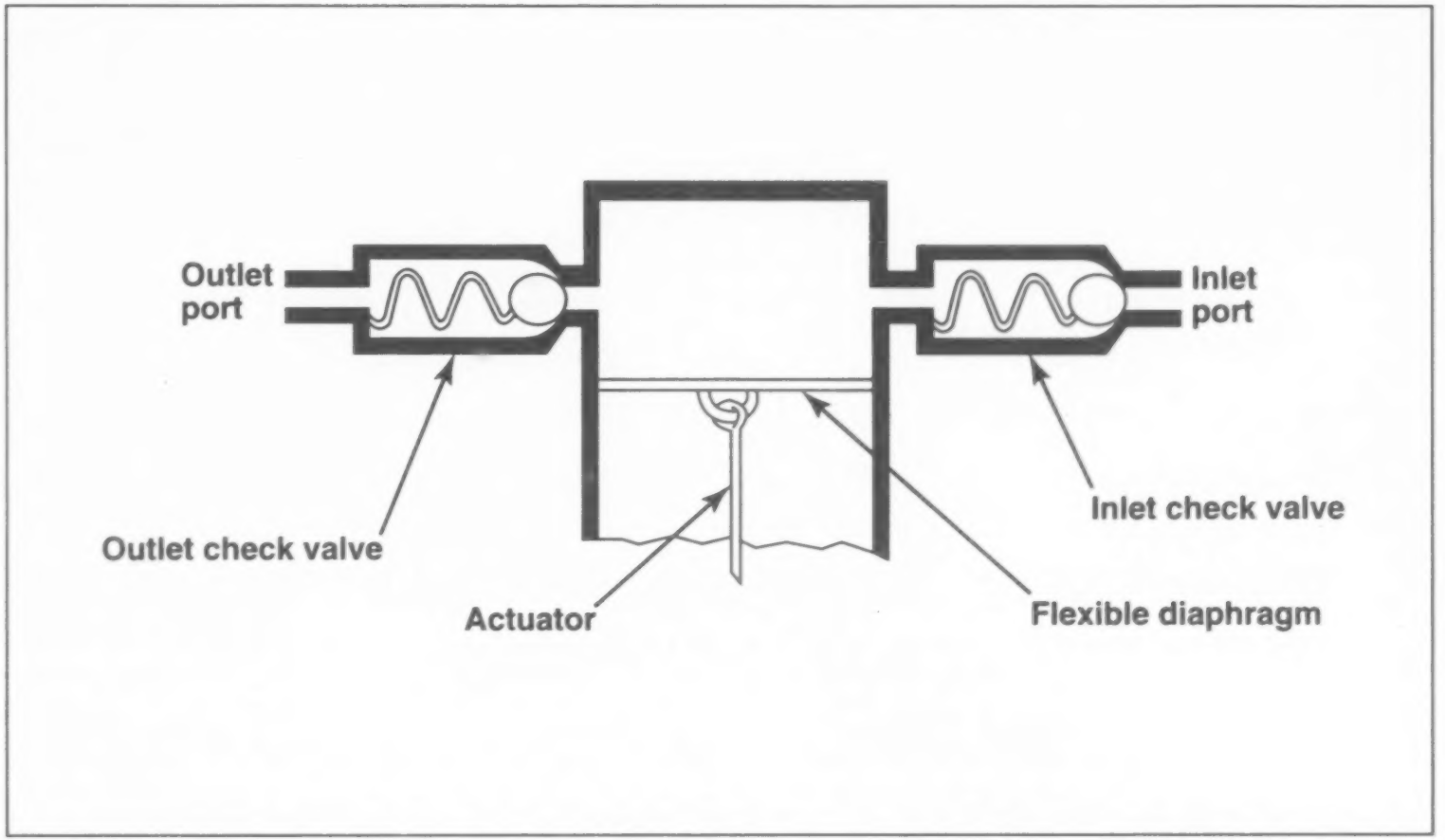
Common Types of Water Pumps:

Reciprocating Pump



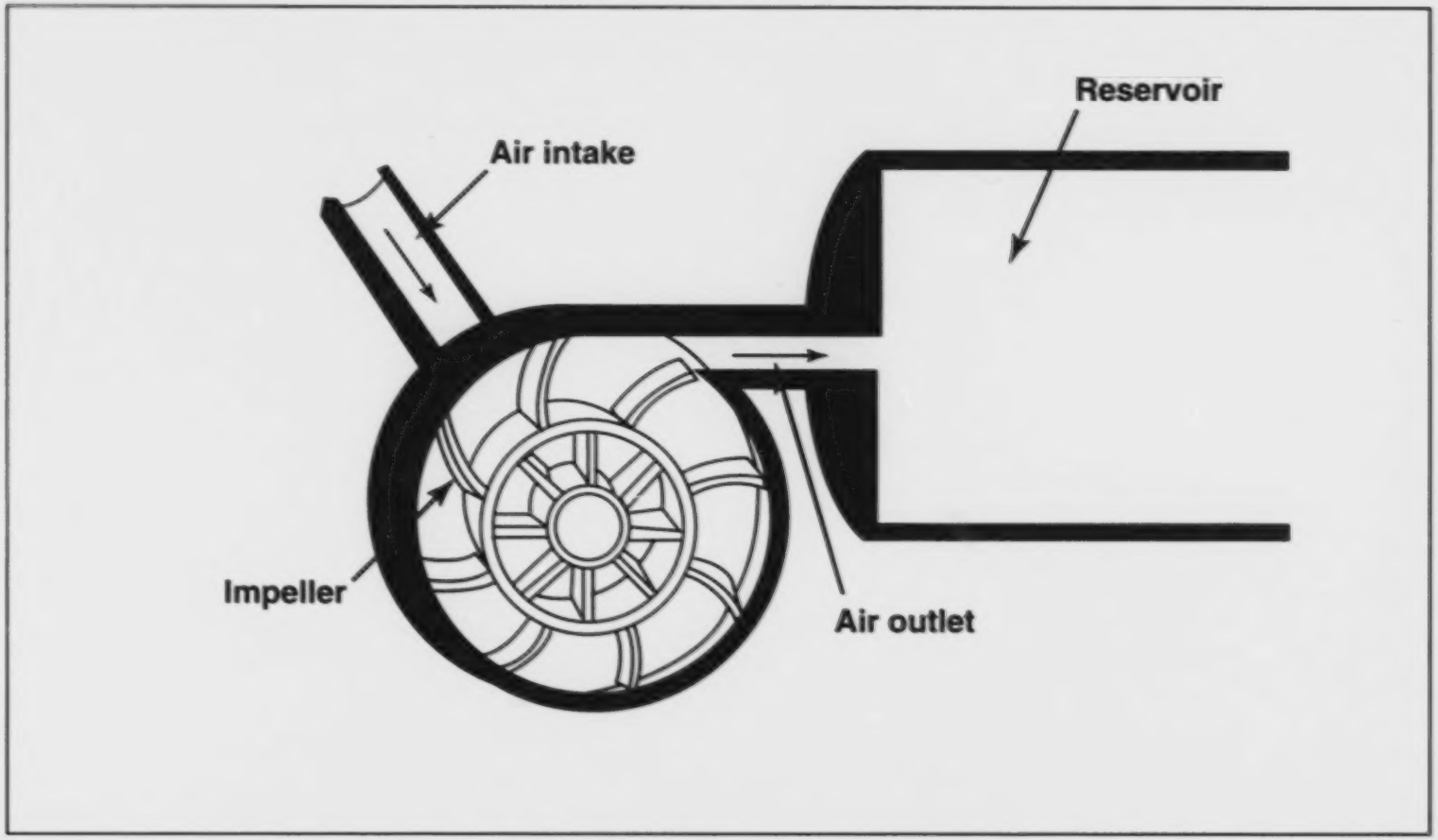
Common Types of Water Pumps:

Diaphragm Pump



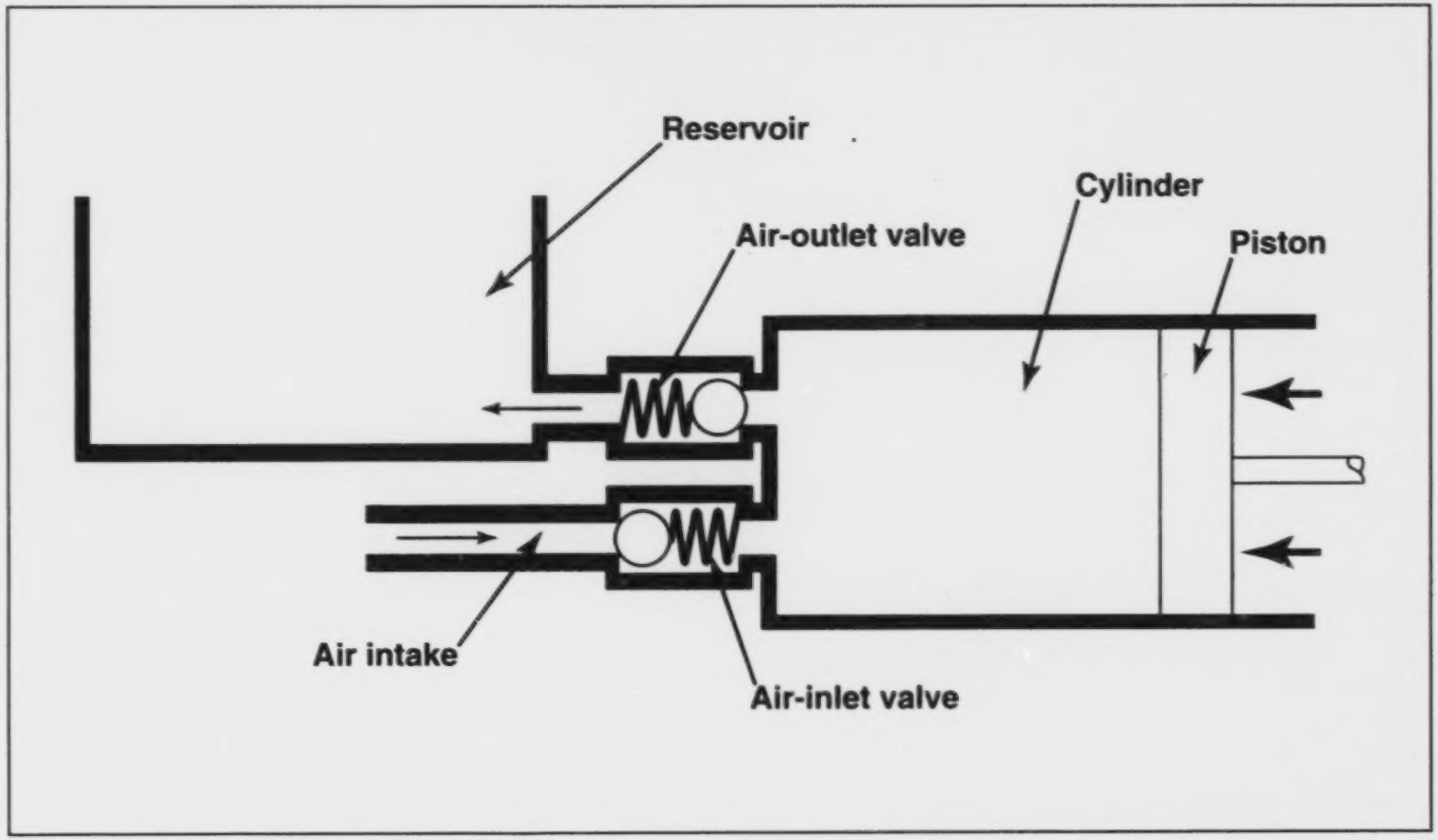
Common Types of Air Compressors:

Rotating Compressor



Common Types of Air Compressors:

Reciprocating Compressor



Job Sheet 1

Worksheet—Perform Routine Maintenance on Water Pumps

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Worksheet—Perform Routine Maintenance on Water Pumps

Part B: Performance evaluation

Evaluation criteria	Rating
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 2

Worksheet—Repair Water Pumps

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Worksheet—Repair Water Pumps

Part B: Performance evaluation

Evaluation criteria	Rating
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Air Compressors

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Worksheet—Perform Routine Maintenance on Air Compressors

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 4

Worksheet—Repair Air Compressors

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Worksheet—Repair Air Compressors

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Alternators, Generators, and Welding Equipment
Unit 3

Suggested Activities

Instructional plan

Preparation

- Review the unit in the student edition and plan your presentation. Study the specific objectives to determine the order in which you will present the objectives.

  Review the unit introduction and teaching suggestions included in the delivery and application section below, and plan classroom activities. Also note suggestions for media and supplemental materials.

  Plan presentation to take advantage of student learning styles and to accommodate special-needs students.

- Prepare the classroom by displaying posters, equipment, and tools related to alternators, generators, and welding equipment.

- Make transparencies from the transparency masters included in the teacher pages of this unit.

- Select teacher components (written test, unit evaluation form) you want to distribute to your students. Copy and prepare these components for distribution.

- Review the job sheets and worksheets in the student edition and locate the worksheet masters included in the teacher pages of this unit. Copy and prepare extra worksheets for distribution to your students.

Delivery and application

Unit introduction

The skill areas appearing in bold-face type in the unit introduction and teaching suggestions refer to the academic and workplace skills identified in *What Work Requires of Schools: A SCANS Report for America 2000* and *Workplace Basics: The Skills Employers Want.* These have been adapted by MAVCC.

- Provide the students with copies of the student materials. You may choose to begin by discussing the objective sheet. Review the unit and specific objectives with the students. Discuss how meeting the unit objective will improve their employability or will increase their value as an employee. Explain how the specific objectives support the unit objective. **(Listening; adapting to the organization's traditional modes of operation; emphasizing personal and career development)**

Suggested Activities

Teaching suggestions

Objective 1 Match terms associated with alternators, generators, and welding equipment to their correct definitions.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Review electrical concepts with the students. Use material from Unit 5, "Basic Electrical Principles," and Unit 8, "Charging Systems," in MAVCC's *Power Product Equipment Technician: Engine Systems and Service*.

- Provide examples of the components and welding processes included in the terms. Demonstrate the design and operation of welding equipment at a level appropriate to this introduction. Discuss applications of AC and DC and relate them to power product equipment. Demonstrate induction and rectification. Relate the terms to the specific objectives in the unit. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 2 State safety rules for working with electrical equipment.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Review various operator's manuals for equipment that will be used with this unit. Demonstrate the proper methods for connecting cables and connectors. Display circuit breakers and fuses; demonstrate their operation and discuss the need for correct matching of protective devices and circuits. Display types of capacitors used with the subject equipment and demonstrate the proper methods for discharging them. Relate safety rules to the remaining specific objectives of this unit. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 3 State definitions of the types of generators.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Use illustrations from various manufacturers and actual equipment to provide examples of the various types of generators. Discuss both the design and construction of each. Have the students use service manuals and other reference materials to examine the various types of generators. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 4 State the functions of the major components of generators.

- Read and discuss with students the information presented in this section of the information sheet. Use Transparency 1, "Major Components of Generators," to aid your discussion. **(Reading/listening for content)**

Suggested Activities

- Use actual equipment to show the major components of generators. Compare and contrast the construction of generators with alternators. Demonstrate the relationship of components to each other. Discuss the purposes of the major components in the various designs. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 5 Complete statements about the principles of operation of generators.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Use illustrations from various manufacturers and actual equipment to demonstrate the operation of generators. Compare the operation of alternators and generators. Discuss the concept of rectification and why AC power is naturally produced. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

- Introduce service requirements based on the design and operation of alternators and generators in preparation for Objective 8. Use the equipment to power other equipment, such as electrical tools. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 6 Describe ways of classifying generators.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Use the discussion in the previous objective to relate the methods of classifying generators to actual designs. Demonstrate induction. Provide examples of each type of phasing. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 7 Match types of rectifiers to their correct descriptions.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Use Transparency 2, "Bridge Rectifiers," and other illustrations to aid your discussion. Also use actual equipment to show applications of each type in actual generators. Provide the students with wiring diagrams and schematics that illustrate the operation of rectifiers in circuits. Show how a diode can be used in a bridge rectifier and discuss the output of each. Discuss semiconductor devices, how they function, and various types of electronic switches used in power product equipment. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Suggested Activities

Objective 8 List the typical service procedures required for alternators and generators.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Provide an overview of applications for alternators and generators and associated service procedures for each type of equipment. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 9 State the functions of the major components of welders.

- Read and discuss with students the information presented in this section of the information sheet. Use Transparency 3, "Major Components of Welders," to aid your discussion. **(Reading/listening for content)**

- Use actual equipment to point out the design features of a single welder and cover them in detail. Discuss variations in designs of welders as an introduction to the next objective. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 10 List types of welders.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Use illustrations from various manufacturers as well as actual equipment to assist the discussion. Build on the previous objective by demonstrating the construction and components used in various designs. Cover applications of various types of welders and discuss advantages and disadvantages of each in specific equipment applications. Discuss differences and similarities among constant-current or constant-voltage designs. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 11 Complete statements about the principles of operation of welders.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

- Build on the previous two objectives to discuss the operation of welders. Review safety procedures in the operation of electrical equipment and welders. Have students review various operator's manuals for the types of welders in your facility. Review the purpose and operation of controls. **(Listening; reasoning; seeing things in the mind's eye; system interrelationships)**

Objective 12 List the typical service procedures required for welders.

- Read and discuss with students the information presented in this section of the information sheet. **(Reading/listening for content)**

Suggested Activities

- Demonstrate the operation of various types of equipment drives. Discuss the role of components in the operation of welders. Give an overview of related service procedures. Demonstrate the required procedures and the specialty tools used. Discuss adjustments and specifications involved in servicing welders. Provide students with service manuals and catalogs necessary to identify part numbers and specifications. **(Listening; reasoning; seeing things in the mind's eye; interpreting and processing information; system interrelationships)**

Assignment Sheet 1 Determine alternator, generator, and welding-equipment service specifications and parts requirements.

- Have students locate Assignment Sheet 1. Read the introduction and directions to the assignment. **(Reading/listening for direction)**

- Make resources available that will allow the students to determine the required information. Tailor the assignment sheet to equipment used in your facility. **(Listening; reading; writing; seeing things in the mind's eye; acquiring, organizing, interpreting, and processing information; system interrelationships)**

- Answer any student questions and have students complete Assignment Sheet 1.

Job Sheet 1 Perform routine maintenance on alternators and generators.

- Have students locate Job Sheet 1 and the worksheet associated with the job sheet. Demonstrate the procedures for performing routine maintenance on alternators and generators. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with alternators and generators that require routine maintenance and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 1.

Job Sheet 2 Repair alternators and generators.

- Have students locate Job Sheet 2 and the worksheet associated with the job sheet. Demonstrate the procedures for repairing alternators and generators. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with alternators and generators that require repair and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 2.

Suggested Activities

Job Sheet 3 Perform routine maintenance on welders.

- Have students locate Job Sheet 3 and the worksheet associated with the job sheet. Demonstrate the procedures for performing routine maintenance on welders. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with welders that require routine maintenance and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 3.

Job Sheet 4 Repair welders.

- Have students locate Job Sheet 4 and the worksheet associated with the job sheet. Demonstrate the procedures for repairing welders. Review with students the worksheet associated with the job sheet, and have them obtain copies of the worksheet for each attempt that will be required.

- Provide students with welders that require repair and have them complete the pre-performance check (Part A) on the worksheet. Evaluate the pre-performance check, and when a student has completed it satisfactorily, have him/her complete Job Sheet 4.

Evaluation

- Evaluate the assignment sheet. See the evaluation criteria listed at the top of the assignment sheet as well as the teacher page "Answers to Assignment Sheet."

- Evaluate the job sheets.

  When the student is ready to perform a specific task, obtain a copy of the worksheet associated with each job sheet. Worksheets may be found in the student edition and in the teacher pages following the transparency masters. Then, observe the student performing the procedure.

  After the student has completed the procedure, rate the student using the criteria provided on the worksheet. If the student's performance is unacceptable, have the student review the materials and perform the procedure again for evaluation.

  Two sample performance evaluation keys are provided below. Many other keys are available. Select one evaluation key (grading scale) that best fits your program needs.

Suggested Activities

Performance Evaluation Keys

Sample A

4 — Skilled—Can perform job with no additional training.
3 — Moderately skilled—Has performed job during training program; limited additional training may be required.
2 — Limited skill—Has performed job during training program; additional training is required to develop skill.
1 — Unskilled—Is familiar with process, but is unable to perform job.

Sample B

Yes—Can perform job with no additional training.

No—Is unable to perform job satisfactorily.

- Give the written test. See the teacher page "Written Test."
- Evaluate the written test. See the teacher page "Answers to Written Test."
- Compile written-test, assignment-sheet, and job-sheet scores. See the teacher page "Unit Evaluation Form."
- Reteach and retest as required.

Suggested resources

Resources used in developing this unit

Print media

- Brumbaugh, James E. *Welders Guide*, 3rd ed. Indianapolis, Indiana: The Bobbs-Merrill Company, Inc., 1983.
- Graf, Rudolf F., and George J. Whalen. *VNR Illustrated Guide to Power Tools*. New York: Van Nostrand Reinhold Company, 1978.
- *Outdoor Power Equipment Repair*. Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, 1985.
- Todd, John. *The Complete Book of Home Welding*. Blue Ridge Summit, Pennsylvania: TAB Books, Inc., 1986.

Suggested supplemental resources

Print media

- *Power Equipment Trade* magazine. Hatton-Brown Publishers, Inc., P O. Box 2268, Montgomery, Alabama 36102.
- Service manuals for equipment covered in this unit.
- Parts catalogs for equipment covered in this unit. Available from equipment manufacturers.

Suggested Activities

Non-print media

- *AC Generator Maintenance.* NUS Training Corporation, 910 Clopper Road, Gaithersburg, Maryland 20878-1399, (800) 848-1717.

  Note: This 60-minute program explains the operation of a simplified AC generator and methods of voltage regulation.

- *Arc Welding Safety and Operations.* American Association for Vocational Instructional Materials, 220 Smithonia Road, Winterville, Georgia 30683-9527, (800) 228-4689.

  Note: This 13-minute program introduces arc-welding equipment and basic safety practices.

- *The Physical World of a Machine.* Tel-A-Train, 309 North Market Street, P.O. Box 4752, Chattanooga, Tennessee 37405, (615) 624-2628.

Alternators, Generators, and Welding Equipment
Unit 3

Answers to Assignment Sheet

Assignment Sheet 1—Student performance should be evaluated according to the criteria listed on the assignment sheet. The answers will depend upon the equipment selected by the instructor.

Alternators, Generators, and Welding Equipment
Unit 3

Answers to Written Test

1.

a.	6	d.	1	g.	5	j.	10
b.	9	e.	8	h.	2	k.	11
c.	7	f.	3	i.	4		

2.
a. Read and follow the manufacturer's recommendations for operation and use of the equipment.
b. Do not use electrical equipment in standing water or on wet surfaces.
c. Observe polarity requirements when making connections.
d. Check all cables, cords, and exposed wiring for adequate insulation, and repair or replace defective wiring.
e. Use protective devices of the specified ratings.
f. Do not attempt to hold circuit breakers closed if they have tripped.
g. Handle one connection at a time whenever possible.
h. Discharge capacitors according to the manufacturer's prescribed procedures before removing if possible or immediately upon removal.

3.
a. Generator that outputs alternating current
b. Generator that uses a rectifier circuit or commutator to output direct current

4.
a. Provides protection and support for electrical and electronic components
b. Provides the power for the production of electricity
c. Rotates as a result of power output from the engine and provides electrical coil or magnetic field for induction of electrical flow
d. Remains stationary and provides electrical coil or magnetic field for induction of electrical flow
e. Converts alternating current to direct current
f. Allow the operator to operate the generator and adjust its functions
g. Provide access to alternating current
h. Provide access to direct current

5.
a. coil; field; rotor; stator
b. field; coil; reverse
c. AC
d. DC
e. output circuit

6. a. A stationary field within which the coil rotates; a stationary coil within which the field rotates

   b. Single-phase output using a single winding; two-phase output using two windings set at 90-degree angles to each other; three-phase output using three windings arranged at 120-degree angles to each other

7. a. An electrical component that allows electrical flow in one direction only so that just half of an alternating current is allowed to complete the circuit

   b. Circuit generally consisting of four diodes arranged in such a way that an alternating-current input produces only direct-current output

   c. Semiconductor device that is normally an open circuit until voltage is applied, at which time the circuit closes to conduct current in only one direction

8. Answer should include any five of the following.

   - Service engine
   - Adjust belt tension
   - Lubricate moving parts
   - Test output
   - Replace fuses
   - Overhaul rotor
   - Replace brushes

9. a. Provides power to the alternator/generator
   b. Produces electricity as a source of heat production for welding
   c. Allow the operator to determine the settings for the equipment
   d. Holds the electrode to provide the current to work and to provide material for the weld
   e. Completes the circuit between the welding equipment and through the work

10. Answers may appear in any order.

    - DC welder
    - AC welder
    - AC/DC welder

11. a. coil; field
    b. DC; voltage
    c. work; electrode
    d. work; electrode; metal; work
    e. ground

12. Answer should include any five of the following.

- Service engine
- Adjust belt tension
- Lubricate moving parts
- Test output
- Replace fuses
- Overhaul rotor
- Replace brushes
- Replace cables and electrodes

Alternators, Generators, and Welding Equipment
Unit 3

Written Test

Name _____ Score _____

1. Match terms associated with alternators, generators, and welding equipment to their correct definitions. Write the numbers on the blanks.

_____ a. Production of electricity through the influence of a magnetic field

_____ b. Process of joining two or more metal parts, usually by means of heat

_____ c. Device used to convert alternating current to direct current

_____ d. Electrical current that switches direction of flow

_____ e. Process by which an electrode is placed on each side of two metals to be joined so that the heat produced as electrical current flows from one piece of metal to the other causes the metals to melt and bond

_____ f. Device used to store excess electrical charge

_____ g. Electrical current that flows in one direction only

_____ h. Process by which an electric arc is used to produce the heat required to melt the materials to be welded

_____ i. Component of a generator usually consisting of a metal ring that is split and the two halves are electrically insulated from each other so that the half that is electrically active changes at the same time that electrical flow reverses direction so that the output of the generator flows in one direction only

_____ j. Portion of an inductive electrical device that remains stationary

_____ i. Portion of an inductive electrical device that rotates

1. Alternating current
2. Arc welding
3. Capacitor
4. Commutator
5. Direct current
6. Induction
7. Rectifier
8. Resistance welding
9. Welding
10. Stator
11. Rotor

2. State safety rules for working with electrical equipment. Write the complete safety rule on the blanks provided beside each of the terms below and on the next page.

a. Manufacturer's recommendations _____

_____

b. Standing water _____

_____

c. Polarity requirements _____

_____

d. Insulation _____

_____

e. Protective devices _____

_____

f. Circuit breakers _____

_____

g. Handling connections _____

_____

h. Discharging capacitors _____

_____

3. State definitions of types of generators. Write your answers on the blanks provided beside the terms below.

a. AC generator _____

_____

b. DC generator _____

_____

4. State the functions of the major components of generators. Write your answers on the blanks provided beside the terms below and on the next page.

a. Housing _____

_____

b. Engine _____

_____

c. Rotor _____

_____

d. Stator _____

_____

e. Rectifier circuit _____

_____

f. Controls _____

_____

g. AC outlets _____

_____

h. DC-outlet/terminals _____

_____

5. Complete statements about the principles of operation of generators. Write your answers on the blanks provided in each of the following statements.

   a. The engine output is used to turn the _____ or the _____; the movement of the _____ in relation to the _____ produces electricity through electromagnetic induction.

   b. As the rotor completes one-half of a rotation, the polar relationship between the _____ and the _____ changes, causing the current flow to _____ direction.

   c. To provide _____ power, the alternating current is conducted to an output circuit such as an outlet.

   d. To provide _____ power, the alternating current is rectified through the use of a commutator or a rectifying circuit.

   e. The rectified current is conducted to an _____, such as an electrical socket or power line.

6. Describe ways of classifying generators. Write your answers on the blank lines provided beside each of the terms below and on the next page.

   a. Induction method _____

_____

_____

_____

b. Output phasing _____

_____

_____

_____

7. Describe types of rectifiers. Write your answers on the blank lines provided beside each of the terms below.

a. Diode _____

_____

_____

b. Bridge rectifier _____

_____

_____

c. Silicon-controlled rectifier _____

_____

_____

8. List five of the typical service procedures required for alternators and generators. Write your answers on the blank lines provided below.

a. _____

b. _____

c. _____

d. _____

e. _____

9. State the functions of the major components of welders. Write your answers on the blanks provided beside each of the terms below and on the next page.

a. Engine _____

_____

b. Alternator/generator _____

_____

c. Controls _____

_____

d. Electrode cable _____

_____

e. Ground cable _____

_____

10. List types of welders. Write your answers on the blank lines provided below.

a. _____

b. _____

c. _____

11. Complete statements about the principles of operation of welders. Write your answers on the blanks provided in the statements below.

a. The engine drives the _____ or _____ shaft of the generator or alternator.

b. The output of the generator or alternator may be rectified if _____ output is desired, or the output may be conditioned through a _____ regulator.

c. Electrical current is provided to the _____ or the _____, depending on the polarity of a DC welder or setup of an AC welder.

d. Current arcs between the _____ and _____, causing an extremely high temperature that melts the _____ of the _____.

e. The _____ cable completes the circuit to the welder.

12. List five of the typical service procedures required for welders. Write your answers on the blank lines provided below.

a. _____

b. _____

c. _____

d. _____

e. _____

Permission to duplicate this test is granted.

Alternators, Generators, and Welding Equipment
Unit 3

Unit Evaluation Form

Student name _____ Unit rating _____

Assignment-sheet rating

Assignment Sheet 1—Determine Alternator, Generator, and Welding-Equipment Service Specifications and Parts Requirements Rating _____

Comments: _____

_____

_____

Job-sheet ratings

Job Sheet 1—Perform Routine Maintenance on Alternators and Generators Rating _____

Comments: _____

_____

_____

Job Sheet 2—Repair Alternators and Generators Rating _____

Comments: _____

_____

_____

Job Sheet 3—Perform Routine Maintenance on Welders Rating _____

Comments: _____

_____

_____

Job Sheet 4—Repair Welders Rating _____

Comments: _____

_____

_____

Unit Evaluation Form

Written-test scores

Pretest _____ Posttest _____ Other _____

Comments: _____

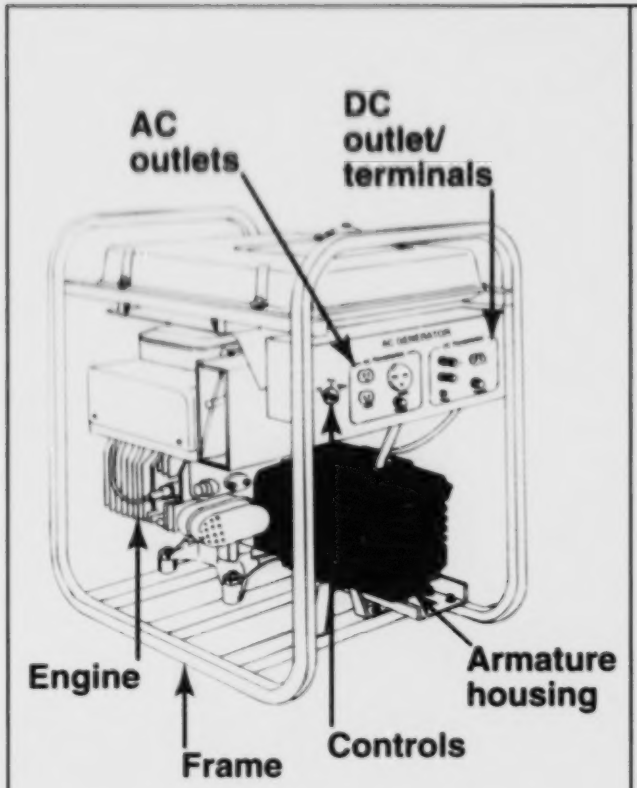
_____

Teacher signature _____ Date _____

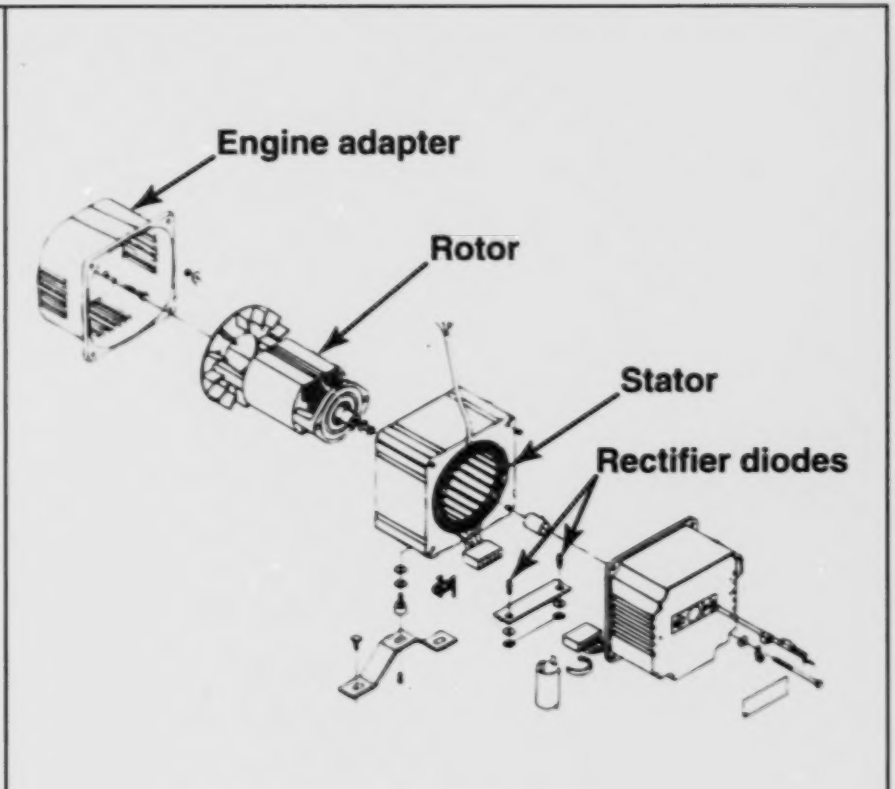
Student signature _____ Date _____

Permission to duplicate this form is granted.

Major Components of Generators



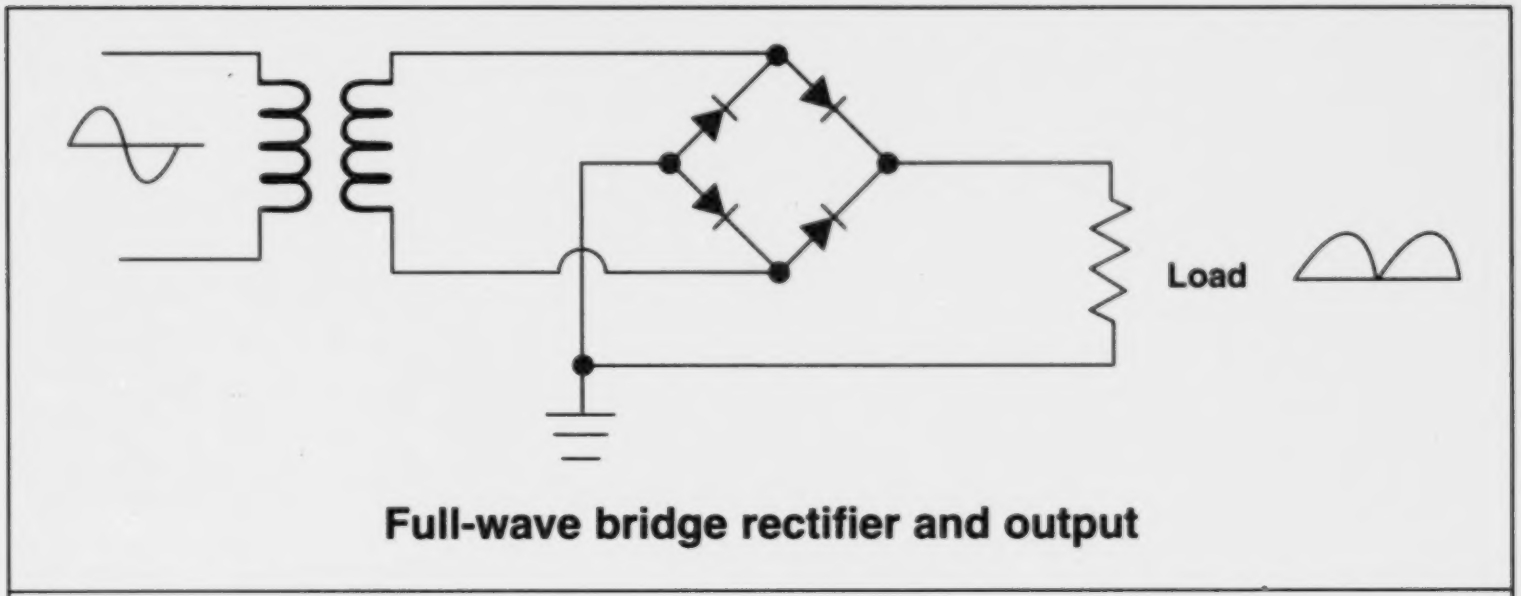
Exterior view



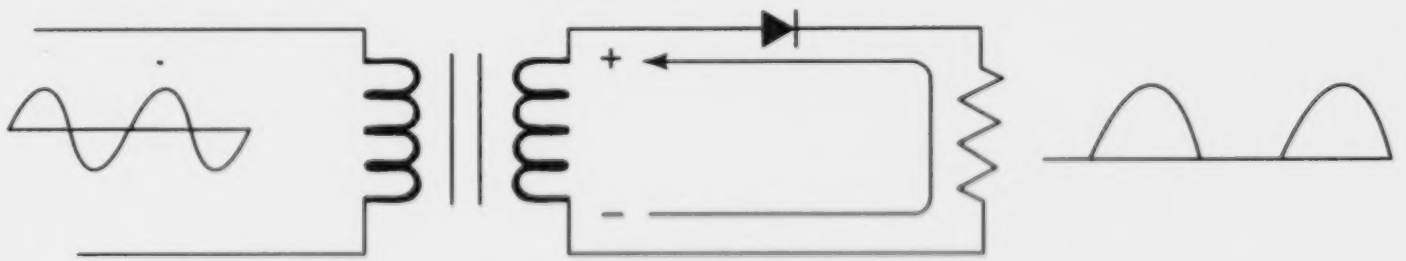
Exploded view

Exploded view reproduced by permission of Coleman Powermate, Inc., Kearney, Nebraska.

Bridge Rectifiers

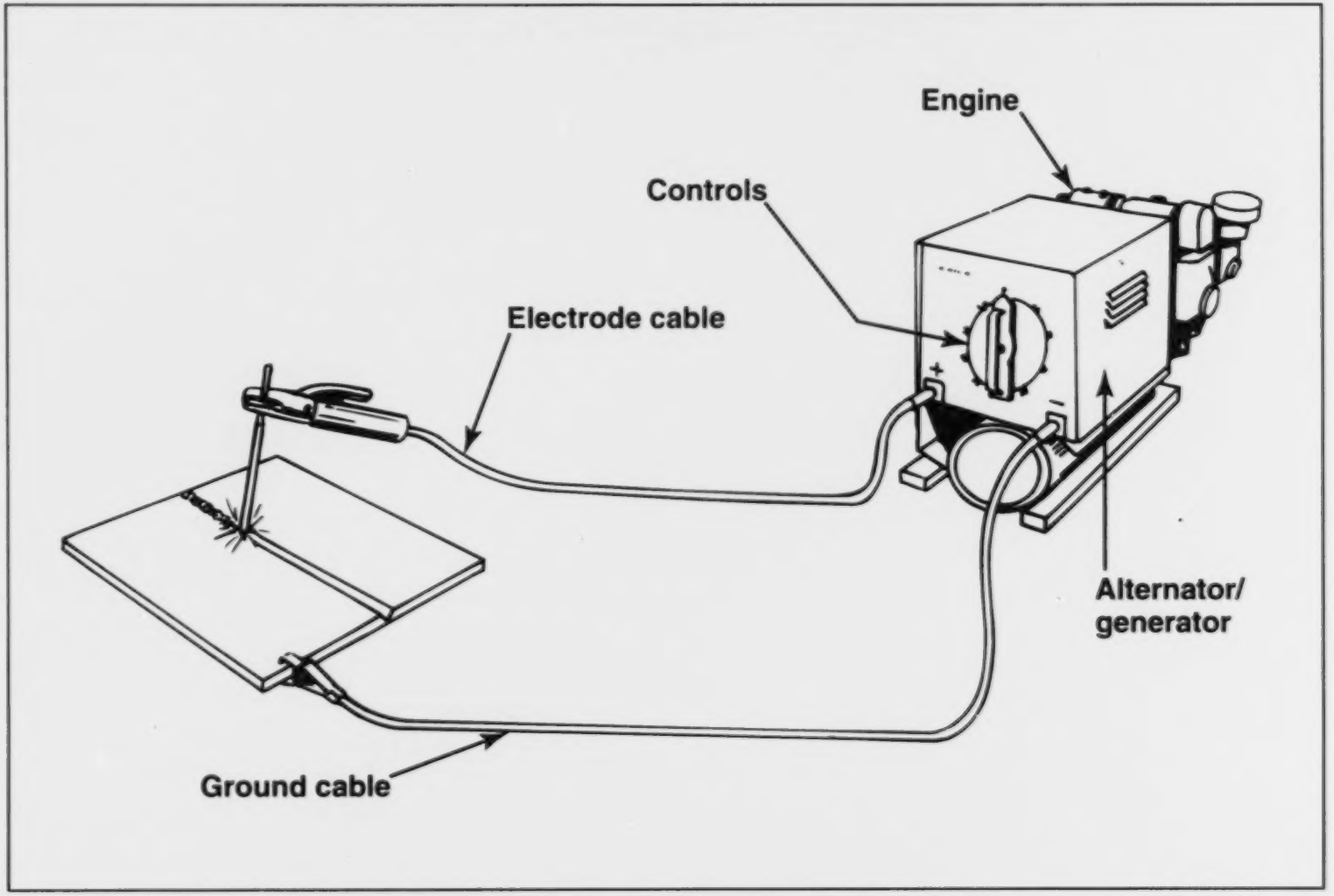


Full-wave bridge rectifier and output



Half-wave bridge rectifier and output

Major Components of Welders



Job Sheet 1

Worksheet—Perform Routine Maintenance on Alternators and Generators

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Worksheet—Perform Routine Maintenance on Alternators and Generators

Part B: Performance evaluation

Evaluation criteria	Rating
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 2

Worksheet—Repair Alternators and Generators

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 2

Worksheet—Repair Alternators and Generators

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Welders

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Welders

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Job Sheet 4

Worksheet—Repair Welders

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 4

Worksheet—Repair Welders

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Power Product Equipment Technician Series

Theory and Principles of Engine Operation

Section A: Orientation

Section B: Basic Engine Theory and Operation

Engine Systems and Service

Section A: Engine Systems

Section B: Engine Overhaul

Equipment Systems

Construction Equipment

Lawn and Garden Equipment

MAVTCC

1500 West Seventh Avenue
Stillwater, OK 74074-4364
1-800-654-3988

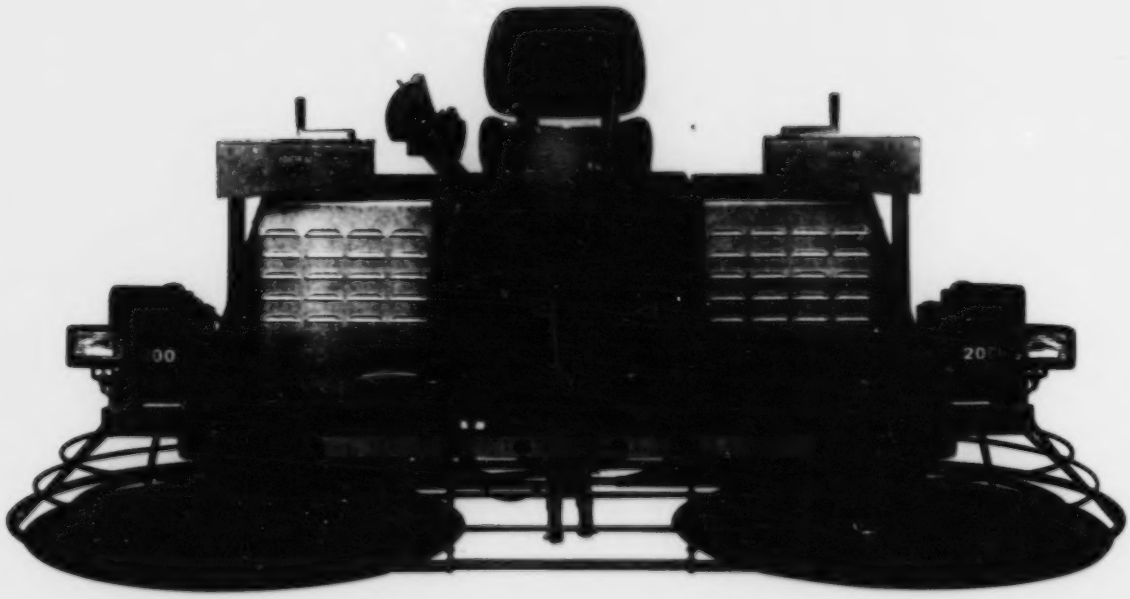
800061

141

99-013308

Power Product Equipment Technician:

Construction Equipment



Student Edition

142

MAVCC

Power Product Equipment Technician:

Construction Equipment

Student Edition

Written by

Robert Hilley, Technical Writer

Project coordinated by

Sue Jones, Curriculum Specialist
Multistate Academic and Vocational Curriculum Consortium, Inc.

Project developed by

The Multistate Academic and Vocational Curriculum Consortium, Inc.
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

©1999

The Multistate Academic and Vocational Curriculum Consortium (MAVCC) does not discriminate on the basis of race, creed, color, national origin, sex, age, religion, veteran status, or qualified handicap.

99-013308

800062

Construction Equipment

Student Edition

Table of Contents

		Page
Unit 1:	**Concrete Equipment**	
	Objective Sheet	1
	Information Sheet	3
	Assignment Sheet	
	1—Determine Concrete-Equipment Service Specifications and Parts Requirements	15
	Job Sheets	
	1—Perform Routine Maintenance on Concrete Mixers	23
	2—Repair Concrete Mixers	27
	3—Perform Routine Maintenance on Concrete-Compacting Equipment	31
	4—Repair Concrete-Compacting Equipment	35
	5—Perform Routine Maintenance on Concrete-Finishing Equipment	39
	6—Repair Concrete-Finishing Equipment	43
Unit 2:	**Water Pumps and Air Compressors**	
	Objective Sheet	47
	Information Sheet	49
	Assignment Sheet	
	1—Determine Water-Pump and Air-Compressor Service Specifications and Parts Requirements	57
	Job Sheets	
	1—Perform Routine Maintenance on Water Pumps	65
	2—Repair Water Pumps	69
	3—Perform Routine Maintenance on Air Compressors	73
	4—Repair Air Compressors	77
Unit 3:	**Alternators, Generators, and Welding Equipment**	
	Objective Sheet	81
	Information Sheet	83
	Assignment Sheet	
	1—Determine Alternator, Generator, and Welding-Equipment Service Specifications and Parts Requirements	91
	Job Sheets	
	1—Perform Routine Maintenance on Alternators and Generators	99
	2—Repair Alternators and Generators	103
	3—Perform Routine Maintenance on Welders	107
	4—Repair Welders	111

Concrete Equipment
Unit 1

Objective Sheet

Unit objective

After completing this unit, the student should be able to identify and maintain and repair common concrete mixing, compacting, and finishing equipment. The student should demonstrate these competencies by completing the assignment sheet and job sheets and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with concrete mixing, compacting, and finishing processes.
2. Match common types of concrete mixers to their correct descriptions.
3. State the functions of the major components of concrete mixers.
4. State the principles of operation of common types of concrete mixers.
5. List the typical service procedures required for concrete mixers.
6. Label common types of equipment used to compact concrete.
7. State the functions of the major components of concrete-compacting equipment.
8. State the principles of operation of common types of concrete-compacting equipment.
9. List the typical service procedures required for concrete-compacting equipment.
10. Label common types of equipment used to finish concrete.
11. State the functions of the major components of concrete-finishing equipment.
12. State the principles of operation of common types of concrete-finishing equipment.
13. List the typical service procedures required for concrete-finishing equipment.
14. State safety rules for working with concrete equipment.
15. Determine concrete-equipment service specifications and parts requirements. (Assignment Sheet 1)
16. Perform routine maintenance on concrete mixers. (Job Sheet 1)
17. Repair concrete mixers. (Job Sheet 2)
18. Perform routine maintenance on concrete-compacting equipment. (Job Sheet 3)

Objective Sheet

19. Repair concrete-compacting equipment. (Job Sheet 4)
20. Perform routine maintenance on concrete-finishing equipment. (Job Sheet 5)
21. Repair concrete-finishing equipment. (Job Sheet 6)

Concrete Equipment
Unit 1

Information Sheet

1. **Terms associated with concrete mixing, compacting, and finishing processes and their definitions**

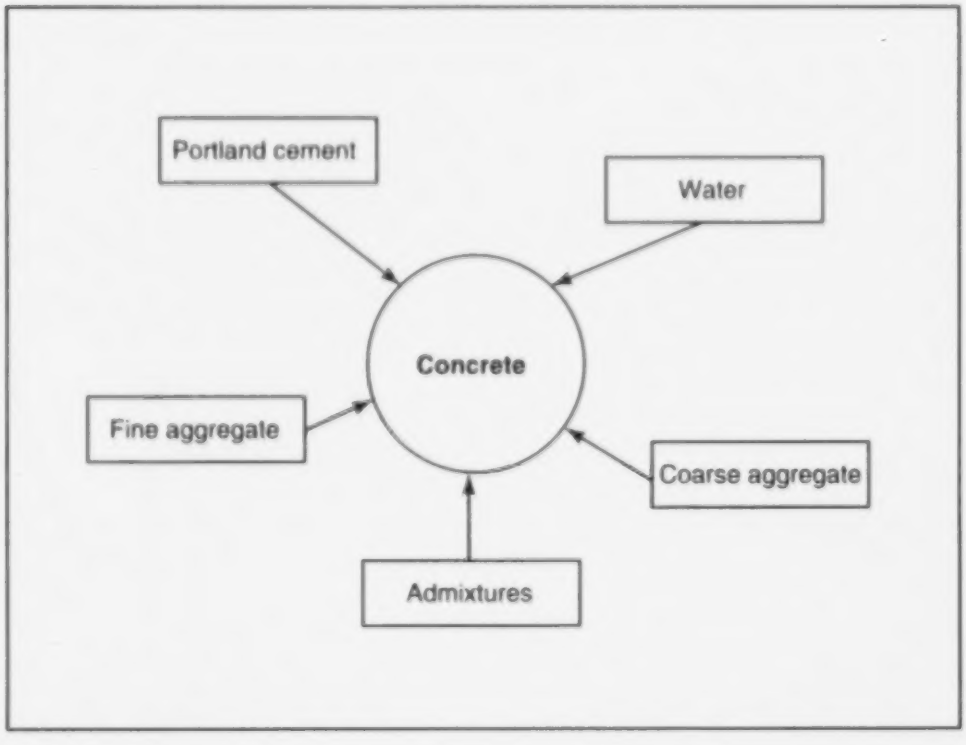
   - **Cement**—Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized; an ingredient in concrete

     Note: During the cement manufacturing process, two types of raw materials—one made primarily from limestone, marl, and shells and another made primarily from clay, shale, silica sand, iron ore, and alumina—are blended, ground, and dried; then, clinker and gypsum are added and that mixture is ground again. After the manufacturing process is complete, cement is ground so finely that it will pass through a #200 sieve, which has 40,000 openings per square inch.

   - **Concrete**—Building material made by mixing cement, sand and aggregates, admixtures, and water

     Note: The elements listed above are mixed in various ratios depending upon the required strength and application (see Figure 1 below). The concrete is then allowed to set (cure) approximately 28 days until it reaches nearly full strength.

     Figure 1: Basic elements of concrete



Information Sheet

- **Form**—Structure built to provide the shape of (to mold) the concrete poured into it

- **Slab**—Layer of concrete 4 to 6 inches thick laid upon a bed of sand that is often reinforced with steel mesh

  Examples: Slab foundations, patios, drives, sidewalks, outdoor basketball and tennis courts

- **Compact**—To tamp and vibrate poured concrete to remove voids from the mixture created during mixing and pouring

  Note: When concrete is mixed and poured, air gets trapped in the mixture and causes air pockets called *voids* to form. If allowed to remain in the concrete, voids would weaken the structure of the cured concrete. Tampers and vibrators are the types of power concrete equipment used to compact concrete after the concrete has been poured into the forms.

- **Finish**—To screed, trowel, or float the surface of the concrete to level the concrete in the form, to remove voids at or near the surface of the mixture, and to obtain a desired surface texture

  Note: The finishing process usually consists of three stages—(1) screeding, (2) troweling and floating, and (3) final finishing. Screeding involves removing excess concrete from the form and then leveling the concrete mixture to the top of the form. Troweling and floating involve running a flat device over the surface of the concrete to compact the concrete, bring a layer of fluid concrete to the surface, and then, to smooth the surface. Final finishing involves creating the desired surface texture required for the finished concrete product. For example, a concrete slab to be used in a patio floor often requires a very smooth surface, while a sidewalk requires a rough surface to improve the traction of people walking on it. Power screeds, trowels, and floats are the types of concrete equipment used in the finishing process.

2. Common types of concrete mixers and their descriptions

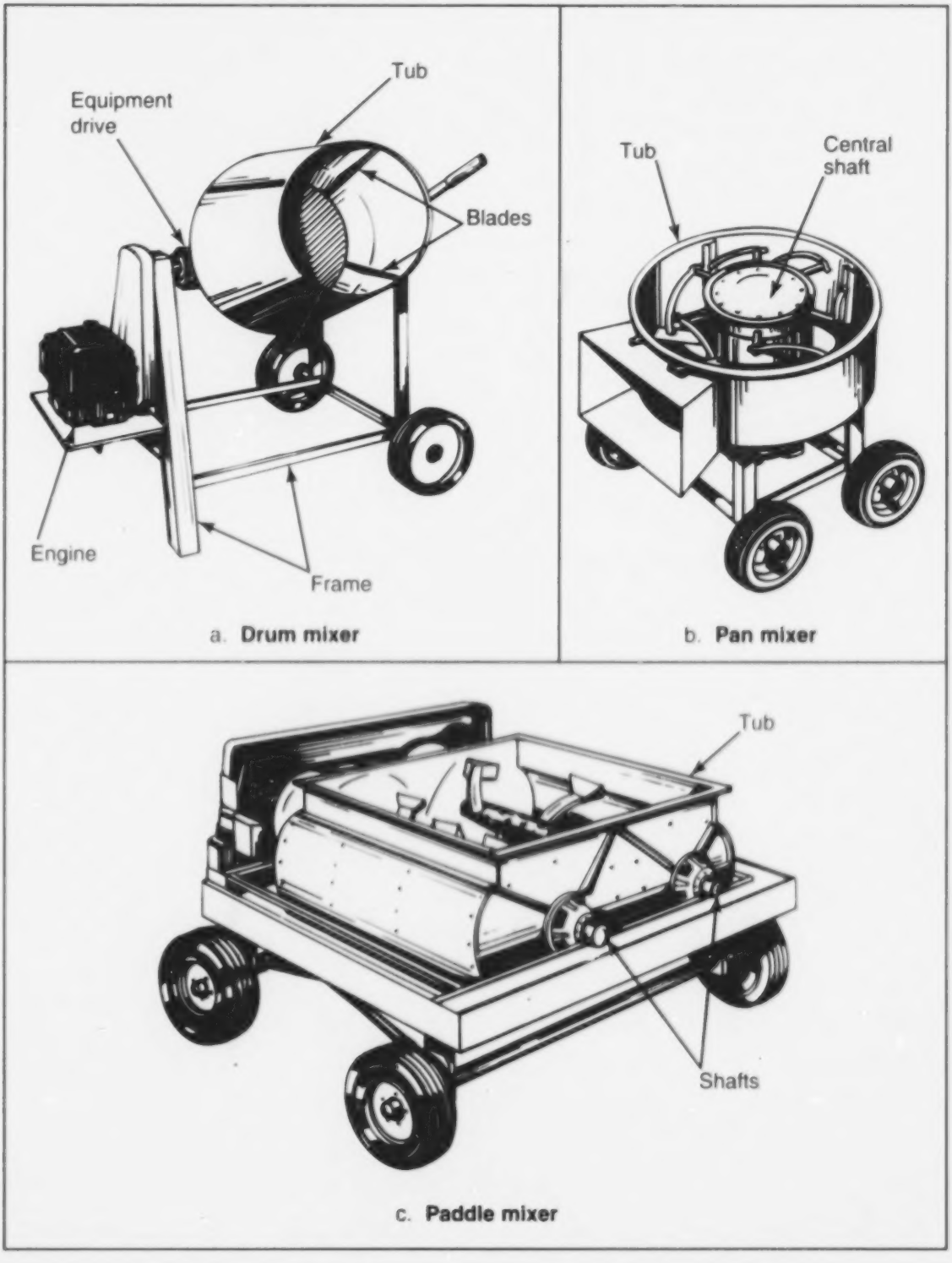
- **Drum** (see Figure 2-a on the next page)—Concrete mixer with an elongated, circular tub with fixed blades attached to the sides of the tub; the tub rotates to move the concrete mixture over the blades

- **Pan** (see Figure 2-b on the next page)—Concrete mixer with a flat, circular tub with a central shaft to which blades are attached; the shaft rotates to move the blades through the concrete mixture

- **Paddle** (see Figure 2-c on the next page)—Concrete mixer with a flat, rectangular tub with at least two shafts to which paddles are attached; the shafts rotate to move the paddles through the concrete mixture

Information Sheet

Figure 2: Common types of concrete mixers



Information Sheet

3. **Major components of concrete mixers and their functions** (see Figure 2-a on the previous page)

   Note: Mixers are used to combine the ingredients used in making concrete into a homogenous mixture and to keep the concrete from hardening (setting) until it has been poured into a form.

   - **Tub**—Holds the concrete mixture and mixes the ingredients used in making the concrete

     Note: Concrete-mixer tubs are usually open and contain three to four blades that mix the concrete. Some mixer tubs also swivel so that the concrete can be poured from the tub.

   - **Engine**—Provides the power to mix the concrete

   - **Equipment drive**—Transmits the power from the engine to the tub

     Note: In the common type of equipment drive used for the drum-type concrete mixer illustrated in Figure 2-a on the previous page, a drive gear is mounted on the end of the engine-output shaft and the base of the tub has teeth that mesh with the drive gear. This arrangement creates a large driven gear that regulates the speed of the tub to make it move much slower than the speed of the engine output. Other types of concrete-mixer equipment drives include belts and chains.

   - **Frame**—Supports the other components of the concrete mixer

     Note: Many concrete mixers must have very heavy frames to support the large tubs and engines required to mix large quantities of concrete. The concrete mixers that require these heavy frames are often built as trailers.

   - **Blades**—Turn to mix the concrete ingredients

     Note: The blades may be built into the tub and turn with the rotation of the tub, or they may rotate independently of the tub.

4. **Principles of operation of common types of concrete mixers**

   Note: For most mixers, the operator manually loads the concrete ingredients into the top of the tub. Generally, the engine is low on the frame and the tub high on the frame. This arrangement makes the tub convenient to the operator during loading and also allows the weight of the engine to counterbalance some of the weight of the concrete when the tub is loaded.

   - **Drum mixers**

     — The engine drives a mechanical (belt or chain) equipment drive or an equipment drive that is directly geared to the base of the tub.

     — The equipment drive drives a shaft, sprocket, or pulley that transmits power from the engine to the drive gear.

     — The drive gear drives a second gear that is attached to or built into the bottom of the tub.

     — The tub rotates on a rail to mix the concrete.

Information Sheet

- **Pan mixers**

  — The engine drives a mechanical (belt or chain) equipment drive.

  — The equipment drive rotates the blade shaft, which has two or more blades mounted to it.

  — The blades rotate within the tub (pan) to mix the concrete.

- **Paddle mixers**

  — The engine drives a mechanical (belt or chain) equipment drive.

  — The equipment drive rotates one or more shafts, each of which has two or more blades mounted to it.

  Note: The equipment drive may drive one or all of the shafts directly. For example, a single belt may drive a pulley on the end of each shaft. In other designs, the equipment drive may be connected to a sprocket or pulley on the end of one shaft with power being transferred from that shaft to other shafts by means of belts or chains.

  — The blades rotate in the tub to mix the concrete.

5. **Typical service procedures required for concrete mixers**

   - Service engine
   - Adjust belt
   - Replace belt
   - Lubricate shafts/gears
   - Clean moving parts

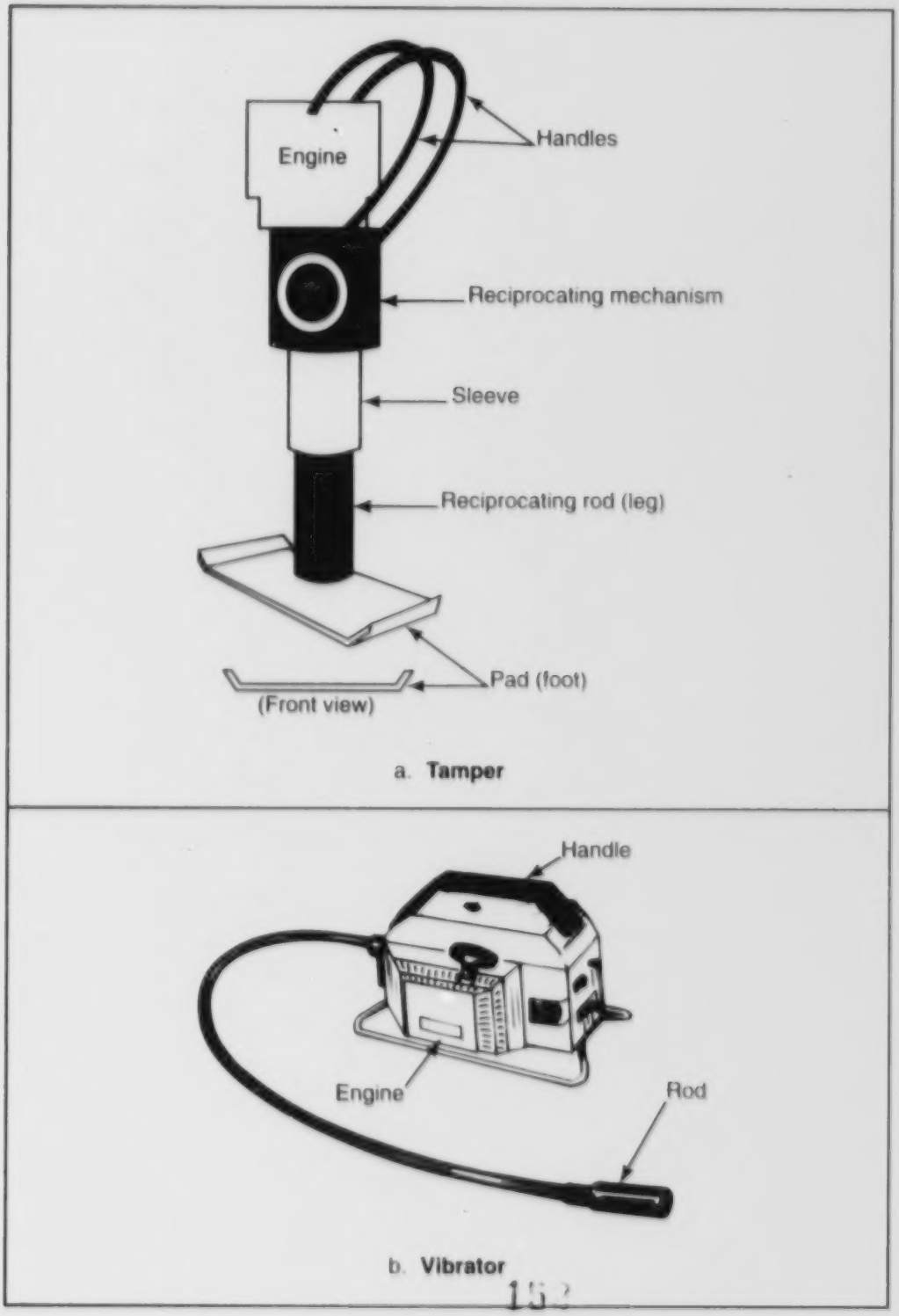
   Note: It is especially important that concrete mixers are kept clean. The ingredients used in making concrete easily fall onto the mixer components as the operator manually loads the tub. If left to accumulate on the mixer, the sand and the cement dust increase the wear on the mixer's moving parts, contaminate lubricants, and break down organic materials such as the rubber used in many drive belts. Additionally, if the concrete mixture is allowed to set up on the mixer, the hardened concrete is very difficult to remove and can interfere with the movement of the mixer components.

6. **Common types of equipment used to compact concrete**

   Note: Tampers and vibrators are used to compact concrete to remove the voids that normally occur when the concrete is poured into a form. If allowed to remain in the concrete mixture, the voids would weaken the structure of the hardened concrete and also allow moisture to collect in the voids. Over time, moisture would break down the internal structure of the concrete as it freezes and thaws with changes in outside temperatures.

   - **Tamper** (see Figure 3-a on the next page)
   - **Vibrator** (see Figure 3-b on the next page)

Figure 3: Common concrete-compacting equipment



Information Sheet

7. **Major components of concrete-compacting equipment and their functions** (see Figure 3-a and Figure 3-b on page 8)

   - **Engine**—Provides rotary power
   - **Handle(s)**—Allows the operator to control the movement of the equipment
   - **Rod**—Provides the motion used to compact the concrete

     Note: With a tamper, the rod moves with an up-and-down (reciprocating) motion. The rod itself may have a blunt or pointed end or may have a pad (foot) attached to it. The choice of a blunt, pointed, or padded rod generally has to do with the size of the concrete area to be compacted. To compact a large slab such as a driveway or foundation for a house, a pad several inches square is attached to the rod. To compact the concrete poured around a fence post, a rod with a pointed end is used.

     A vibrator consists of an engine and a flexible rod. The rod produces low-frequency vibrations and is inserted into the concrete to cause the aggregates to realign, close voids, and allow air to escape.

8. **Principles of operation of common types of concrete-compacting equipment**

   Note: As with other types of equipment, the power for concrete-compacting equipment may be provided by sources other than internal-combustion engines. Electric and pneumatic systems are common at construction sites, and hydraulic or other sources may also be used.

   - **Tampers**

     Note: Tampers are also used to compact soil, gravel, sand, and surfaces other than concrete.

     — An engine drives an equipment drive that converts the rotary motion from the engine into reciprocating motion that drives a rod.

       Note: Reciprocating motion is normally transmitted by use of spindles and rods.

     — When the rod is inserted into the concrete, the reciprocating motion of the rod compacts the concrete mixture.

   - **Vibrators**

     — An engine is linked to a cable that rotates inside the rod to create low-frequency vibrations.

     — When the rod is inserted into the concrete, the low-frequency vibrations from the rod compact the concrete mixture.

9. **Typical service procedures required for concrete-compacting equipment**

   - Service engine
   - Lubricate linkages

Information Sheet

10. Common types of equipment used to finish concrete

Note: Finishing equipment rides over the surface of concrete slabs to smooth the concrete's surface and to eliminate surface and near-surface voids.

- **Disc-type float** (Kelly float) (see Figure 4-a below)
- **Pony trowel** (see Figure 4-b below)

  Note: The type of small, light trowel shown in Figure 4-b is used for finishing small slabs. Heavier versions of this type of trowel equipped with larger engines and larger-diameter blades are used on larger slabs.

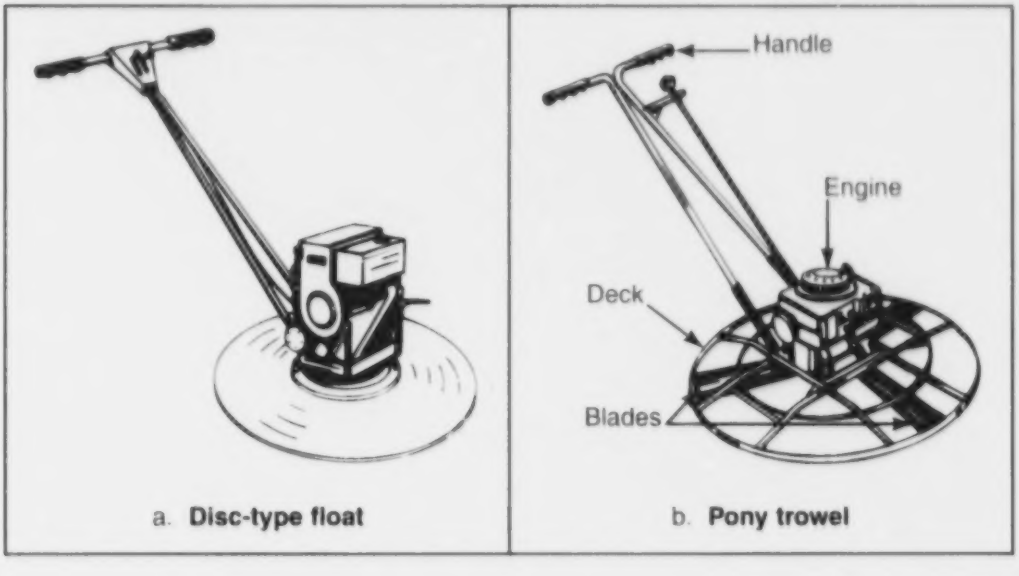
- **Operator-ridden trowel** (see Figure 5-a on the next page)

  Note: The typical operator-ridden trowel shown in Figure 5-a has two rotary blades. Direction is controlled by how much of the total power output is directed to each rotary blade—the machine tends to move in the direction of the rotary blade that receives the larger portion of the power.

- **Power screed** (see Figure 5-b on the next page)

  Note: A power screed consists of a metal frame that supports the screed blades and a series of vibrators. An engine operates the vibrators. Power screeds are used for finishing long slabs such as drives and highways. During use, the screed frame rests on the concrete forms on each side of the poured concrete, and the screed moves along the forms. Movement of the screed may be engine-powered or manual, with one person at each end of the screed using handles or winches to pull it along the form.

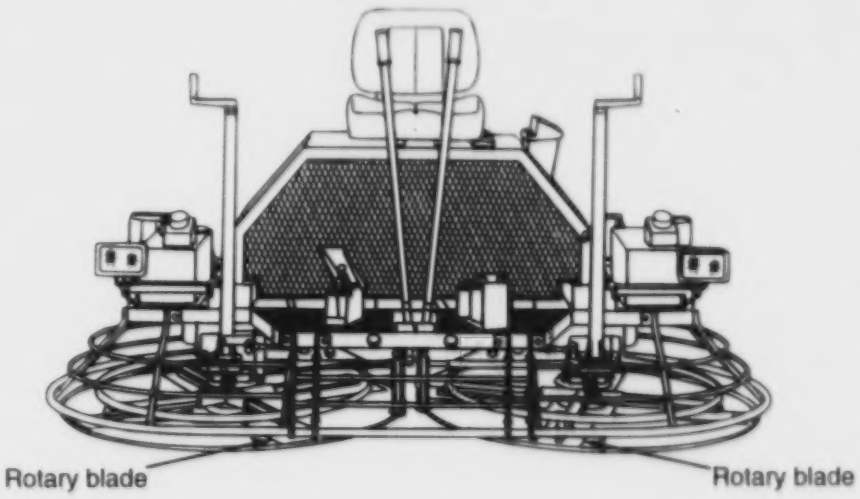
Figure 4: Common concrete-finishing equipment



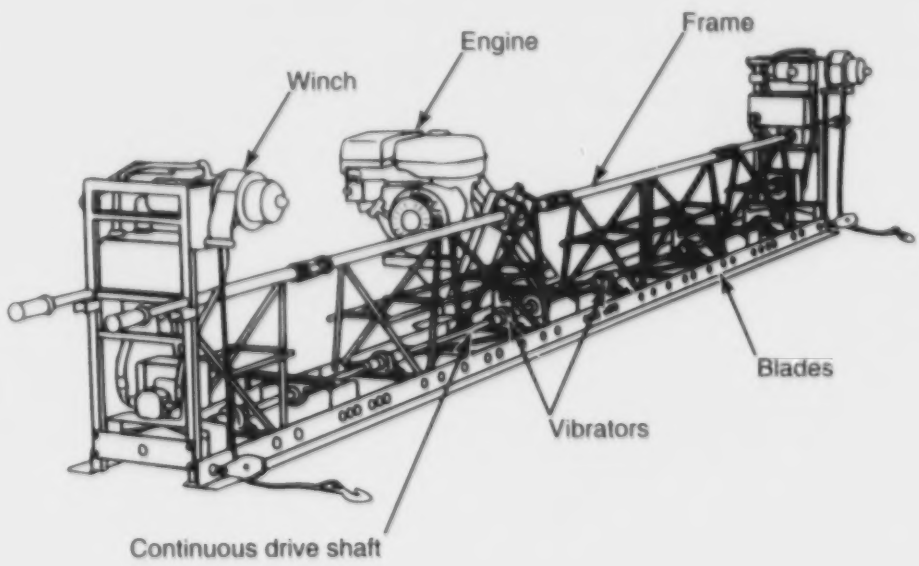
a. **Disc-type float** b. **Pony trowel**

Information Sheet

Figure 5: Common concrete-finishing equipment (cont.)



a. **Operator-ridden trowel**



b. **Power screed**

Figures 5-a and 5-b reproduced by permission of Allen Engineering Corporation, Paragould, Arkansas.

Information Sheet

11. **Major components of concrete-finishing equipment and their functions** (see Figure 4-b on page 10)

- **Engine**—Provides rotary power
- **Handle**—Allows the operator to control and guide the finishing equipment
- **Deck**—Supports the engine and protects the blades

  Note: The deck is usually a tubular metal frame that supports the engine and protects the blades. The deck may also have a piece of sheet metal or metal mesh that provides additional support for the engine.

- **Blades**—Move over the concrete to smooth its surface

  Note: Concrete-finishing equipment is equipped with a set of broad, flat blades that rest on the concrete to be finished. The rotation of the blades works the gravel down into the concrete and smooths the surface. The angle of the blades is usually adjustable so that they can be set parallel to the surface of the concrete or at an angle to it. The blades are set at an angle to begin the finishing process and are set closer to parallel as the finishing process progresses.

12. **Principles of operation of common types of concrete-finishing equipment**

Note: Although the terms used to identify concrete-finishing equipment are not applied in precisely the same way throughout the industry, in this course, we have tried to standardize the terminology to make learning easier. Floats compact aggregates near the surface and ensure that a layer of cement covers the aggregates. Trowels smooth the surface layer of cement. For power applications, the real difference between floats and trowels is in the type of blades used. This book refers to equipment with disc blades as *floats* and those with propeller-type blades as *trowels*. The operation of these two types of equipment is essentially the same.

- **Floats and trowels**
  - — The output shaft of the engine is generally mounted directly to the disc or blades.
  - — The rotary motion of the engine drives the disc or blades.
  - — The rotation of the disc or blades causes the concrete to vibrate so that cement is forced into any voids near the surface.
- **Screeds**
  - — The output of the engine drives an equipment drive.
  - — The equipment drive generally converts the rotary motion of the engine into a reciprocating motion.
  - — The reciprocating motion drives a blade or blades that move across the surface of the concrete to compact it and level it, pushing excess concrete ahead of the screed as it moves across the concrete.

    Note: The screed moves over the surface of the concrete either on its own power or driven by an outside power source. The same engine that drives the screed blade may be used to power drive wheels. In other designs, the screed may be moved manually with an operator at each end of the screed. Finally, some screeds are designed to be mounted to trucks, tractors, or other types of vehicles that drive along side or straddling the surface to be screeded.

Information Sheet

13. Typical service procedures required for concrete-finishing equipment

- Service engine
- Lubricate blade shaft
- Maintain fasteners
- Replace blades

14. Safety rules for working with concrete equipment

Note: When you service power product equipment, follow all the basic workplace safety rules you learned in Unit 1 in *Theory and Principles of Engine Operation, Section A: Orientation*, but when working with concrete equipment, remember to also obey these specific safety rules.

- **Concrete equipment is often very heavy; follow proper lifting procedures and remember that this equipment may be too heavy for one person to lift or carry.**
- **Level and properly block concrete mixers before operating.**

  Note: Concrete mixers are designed to be set up and operated on site. Mixers must be level and properly blocked to keep them from tipping or rolling over and also to keep them from vibrating excessively during operation.

- **Do not touch hot engines or friction-heated parts of concrete equipment.**

  Note: Equipment engines and parts may be hot enough to cause serious burns.

- **Wear protective breathing equipment as necessary when working with concrete equipment.**

  Note: Concrete equipment may be coated with concrete dust, which can irritate the lungs. Wear protective breathing equipment as necessary.

Concrete Equipment
Unit 1

Assignment Sheet 1—Determine Concrete-Equipment Service Specifications and Parts Requirements

Name _____ Date _____

Evaluation criteria	Rating
Directions have been followed.	_____
Minimum of 85 percent of answers are correct.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Introduction

There are many types of power product equipment used to support the construction trades. In addition to those covered in this unit, there are concrete saws, conveyor belts, and numerous other types of concrete equipment powered by gasoline- and diesel-fueled engines. Some are common throughout the country and some are found most often in certain areas of the country or in either urban or rural areas. For this reason, the types of concrete equipment that a technician must service can vary greatly. Your training facility and your future work experience may or may not expose you to all of the equipment covered in this unit, and it is quite likely that you will encounter types of equipment not mentioned in these materials. This assignment sheet is intended to help you learn more about the concrete equipment commonly used in your region of the country. Using equipment assigned by your instructor, you will determine part numbers, specifications, and other service-related information about that equipment.

Exercise

Directions

Your instructor will complete the first three blanks for each section of this assignment sheet. Using the resources available in your facility, determine the part numbers and specifications requested in questions 1 through 10 of each section. Write your answers on the blanks provided with each question.

Assignment Sheet 1

Part A

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

3. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

4. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

5. What is the recommended idle rpm?

   Idle rpm — _____

6. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

7. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Assembly type(s) — _____

Assignment Sheet 1

b. If pneumatic tires are used, what is the recommended inflation?

Recommended inflation — _____

c. What is the recommended lubricant for the wheel bushings or bearings?

Recommended lubricant — _____

d. What is the recommended lubrication-service interval?

Service interval — _____

8. What is the major driven component and its part number?

Examples: Mixer paddles or tub, finishing trowel or disc, etc.

Driven component — _____

Part number — _____

9. What type of operator controls are provided, and what service procedures are associated with them?

Operator controls — _____

_____

_____

Required service procedures — _____

_____

_____

10. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

_____

_____

_____

_____

_____

Assignment Sheet 1

Part B

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

3. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

4. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

5. What is the recommended idle rpm?

   Idle rpm — _____

6. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

7. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Assembly type(s) — _____

      _____

Assignment Sheet 1

b. If pneumatic tires are used, what is the recommended inflation?

Recommended inflation — _____

c. What is the recommended lubricant for the wheel bushings or bearings?

Recommended lubricant — _____

d. What is the recommended lubrication-service interval?

Service interval — _____

8. What is the major driven component and its part number?

Examples: Mixer paddles or tub, finishing trowel or disc, etc.

Driven component — _____

Part number — _____

9. What type of operator controls are provided, and what service procedures are associated with them?

Operator controls — _____

_____

_____

Required service procedures — _____

_____

_____

10. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

_____

_____

_____

_____

_____

Assignment Sheet 1

Part C

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

3. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

4. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

5. What is the recommended idle rpm?

   Idle rpm — _____

6. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

7. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Assembly type(s) — _____

Assignment Sheet 1

b. If pneumatic tires are used, what is the recommended inflation?

Recommended inflation — _____

c. What is the recommended lubricant for the wheel bushings or bearings?

Recommended lubricant — _____

d. What is the recommended lubrication-service interval?

Service interval — _____

8. What is the major driven component and its part number?

Examples: Mixer paddles or tub, finishing trowel or disc, etc.

Driven component — _____

Part number — _____

9. What type of operator controls are provided, and what service procedures are associated with them?

Operator controls — _____

_____

_____

Required service procedures — _____

_____

_____

10. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

_____

_____

_____

_____

_____

Concrete Equipment
Unit 1

Job Sheet 1—Perform Routine Maintenance on Concrete Mixers

Introduction

This job sheet covers the routine maintenance associated with concrete mixers. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Inspect mechanical components
- Adjust belt tension
- Align pulleys and shafts
- Lubricate moving parts

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of performing routine maintenance on concrete mixers and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one concrete mixer. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with a concrete mixer that requires routine maintenance.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 1

Worksheet—Perform Routine Maintenance on Concrete Mixers

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 1

Worksheet—Perform Routine Maintenance on Concrete Mixers

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Concrete Equipment
Unit 1

Job Sheet 2—Repair Concrete Mixers

Introduction

This job sheet covers the repair procedures associated with concrete mixers. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Replace mechanical components
- Overhaul mechanical subsystems, including gearboxes, bearings, and pulley systems
- Perform adjustments to return equipment to original specifications

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of repair of concrete mixers and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one concrete mixer. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with a concrete mixer that requires repair.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 2

Worksheet—Repair Concrete Mixers

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 2

Worksheet—Repair Concrete Mixers

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Concrete Equipment
Unit 1

Job Sheet 3—Perform Routine Maintenance on Concrete-Compacting Equipment

Introduction

This job sheet covers the routine maintenance associated with concrete-compacting equipment. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Inspect mechanical components, including springs and cam
- Lubricate gears, chains, and shafts
- Inspect for oil and fuel leaks
- Adjust belt tension
- Align pulleys and shafts

Note: Tampers are also used to compact soil, gravel, sand, and surfaces other than concrete. Your instructor may assign you tampers designed for these purposes, too.

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of performing routine maintenance on concrete-compacting equipment and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one type of compacting equipment. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with concrete-compacting equipment that requires routine maintenance.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 3

Worksheet—Perform Routine Maintenance on Concrete-Compacting Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Concrete-Compacting Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Concrete Equipment
Unit 1

Job Sheet 4—Repair Concrete-Compacting Equipment

Introduction

This job sheet covers the repair procedures associated with concrete-compacting equipment. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Replace mechanical components, including gears, belts, springs, etc.
- Overhaul mechanical subsystems, including gearboxes and pulley systems
- Perform adjustments to return equipment to original specifications

Note: Tampers are also used to compact soil, gravel, sand, and surfaces other than concrete. Your instructor may assign you tampers designed for these purposes, too.

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of repairing concrete-compacting equipment and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one type of compacting equipment. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with concrete-compacting equipment that requires repair.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 4

Worksheet—Repair Concrete-Compacting Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 4

Worksheet—Repair Concrete-Compacting Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Concrete Equipment
Unit 1

Job Sheet 5—Perform Routine Maintenance on Concrete-Finishing Equipment

Introduction

This job sheet covers the routine maintenance associated with concrete-finishing equipment. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Inspect mechanical components, including blades
- Lubricate moving parts
- Adjust belt tension
- Align pulleys and shafts

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of performing routine maintenance on concrete-finishing equipment and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one type of finishing equipment. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with concrete-finishing equipment that requires routine maintenance.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 5

Worksheet—Perform Routine Maintenance on Concrete-Finishing Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 5

Worksheet—Perform Routine Maintenance on Concrete-Finishing Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Concrete Equipment
Unit 1

Job Sheet 6—Repair Concrete-Finishing Equipment

Introduction

This job sheet covers the repair procedures associated with concrete-finishing equipment. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Replace mechanical components, including, gears, belts, blades, etc.
- Overhaul mechanical subsystems, including gearboxes and pulley systems
- Perform adjustments to return equipment to original specifications

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of repairing concrete-finishing equipment and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one type of finishing equipment. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with concrete-finishing equipment that requires repair.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 6

Worksheet—Repair Concrete-Finishing Equipment

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 6

Worksheet—Repair Concrete-Finishing Equipment

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Water Pumps and Air Compressors
Unit 2

Objective Sheet

Unit objective

After completing this unit, the student should be able to maintain and repair water pumps and air compressors used in portable field applications. The student should demonstrate these competencies by completing the assignment sheet and job sheets and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. State the functions of the major components of water pumps.
2. Label common types of water pumps.
3. State the principles of operation of common types of water pumps.
4. List typical service procedures required for water pumps.
5. State the functions of the major components of air compressors.
6. Label common types of air compressors.
7. State the principles of operation of common types of air compressors.
8. List typical service procedures required for air compressors.
9. State safety rules for working with water pumps and air compressors.
10. Determine water-pump and air-compressor service specifications and parts requirements. (Assignment Sheet 1)
11. Perform routine maintenance on water pumps. (Job Sheet 1)
12. Repair water pumps. (Job Sheet 2)
13. Perform routine maintenance on air compressors. (Job Sheet 3)
14. Repair air compressors. (Job Sheet 4)

Water Pumps and Air Compressors
Unit 2

Information Sheet

1. **Major components of water pumps and their functions** (see Figure 1 on page 50)

   Note: Although this unit discusses pumps as a means of moving water specifically, pumps can be used to move many other liquids, such as oil, hydraulic fluid, gasoline, molasses, milk, etc. However, the pumps used to move liquids other than water often use electric motors and are located inside industrial plants (and are, therefore, called *plant-application pumps*). Pumps used in the field (and, therefore, called *field-application pumps*) are classified as either *fixed* or *portable*. Fixed field-application pumps typically have large, multiple-cylinder engines often fueled by diesel or compressed natural gas. Oil-field pumping stations are examples of fixed field-application pumps. Portable field-application pumps, such as those used in irrigation systems and firefighting equipment, generally use power product equipment engines or obtain power from a vehicle engine. This unit, then, deals with the types of pumps that are used in portable field applications and are powered by small gasoline engines.

   - **Engine**—Provides the rotary power to turn the engine-output shaft
   - **Engine-output shaft**—Transmits the rotary power from the engine to the pump impeller

     Note: The engine-output shaft may be a PTO of the engine crankshaft, or it may be connected to the pump by belts, chains, or gears.

   - **Casing**—Houses the pump
   - **Impeller**—Moves water through the pump

     Note: There are two principal types of impellers: (1) axial flow and (2) rotary flow. If the rotation of the impeller is perpendicular to the direction of fluid flow, like the rotation of a boat propeller in water, it is called an *axial-flow impeller*. If the rotation of the impeller is parallel to the direction of fluid flow, it is called a *rotary-flow impeller*. There are three variations of the rotary-flow impeller design: (1) open, (2) semi-open, and (3) closed (enclosed). These design variations are distinguishable by whether or not side plates surround the impeller. If there are no side plates around a rotary-flow impeller, it is called *open*; if there is a plate on one side of a rotary-flow impeller, it is called *semi-open*; and if there are side plates on both sides of a rotary-flow impeller, it is called *closed* (or *enclosed*).

   - **Water-inlet port**—Allows water to enter the casing

     Note: Water pumps—particularly the centrifugal pumps you will study in the next objective—operate in what is called an *unbalanced condition* because one portion of the impeller is loaded with water while the other portion is not. To counteract this unbalanced condition and reduce the end thrust on the shaft that would result in shaft wear, many pumps have multiple inlets and more than one impeller driven by the shaft. The technician should be aware of how these pump components are designed to provide proper balance so that he or she will select proper parts and install them correctly.

   - **Water-outlet port**—Allows water to exit the casing

Information Sheet

2. Common types of water pumps

Note: The choice of pump design selected for a particular job in the field depends on the application. There are two general pump applications: (1) water has to be raised from one level to the next or (2) the water has to be moved from one location to another on the same level. The different types of pump designs differ in their ability to raise water. Other factors, such as cost, complexity, and availability, also affect the type of pump selected for a particular field application.

- **Centrifugal** (see Figure 1-a below)

  Note: Centrifugal pumps use centrifugal force to move water from a central input port to the outer rim of the pump body.

- **Rotary** (see Figure 1-b below)

  Note: The primary force at work in a rotary water pump is the rotation of the impeller, which displaces water from the inlet to a more restricted area by the outlet. Figure 1-b shows a vane-type rotary pump (also called a *sliding-vane pump*); however, gear and rotary pumps are also available.

- **Reciprocating** (see Figure 2-a on the next page)

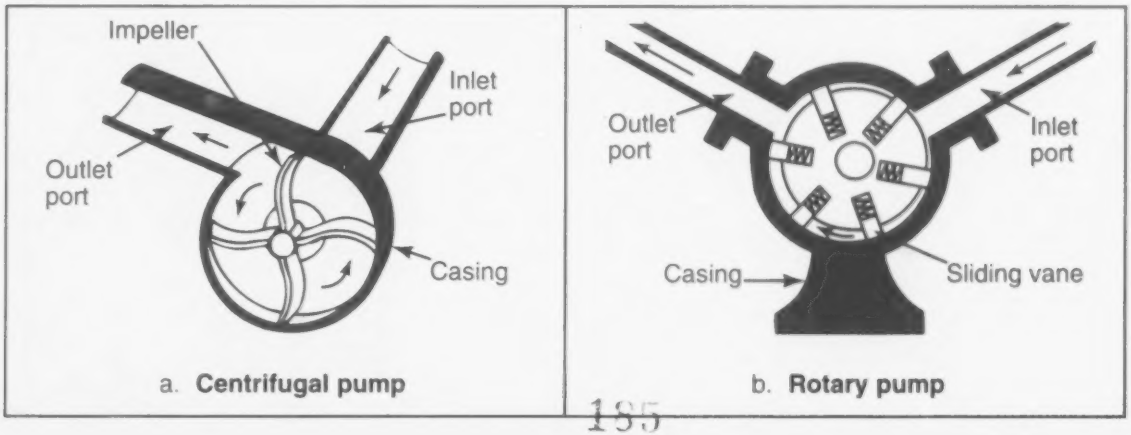
  Note: Reciprocating pumps are used to raise water; however, this type of pump is limited in its ability to do so. A reciprocating pump can lift only so much weight, and the taller the column of water it must lift, the more the water weighs; this factor coupled with leakage and the resistance between the water and the inlet pipe limit a reciprocating pump's ability to raise water to no more than approximately 25 feet.

  There are two types of reciprocating pumps: (1) a lift pump and (2) a force pump. A lift pump is shown in Figure 2-a, but a force pump is similar in design—the main difference being that, in a force pump, both the inlet and outlet valves are placed at the closed end of the cylinder.

- **Diaphragm** (see Figure 2-b on the next page)

  Note: Diaphragm pumps operate by using a flexible membrane that is driven by an engine to change the volume of a pump chamber. These changes of volume create pressure differentials that cause a flow of fluids from high-pressure areas to low-pressure areas.

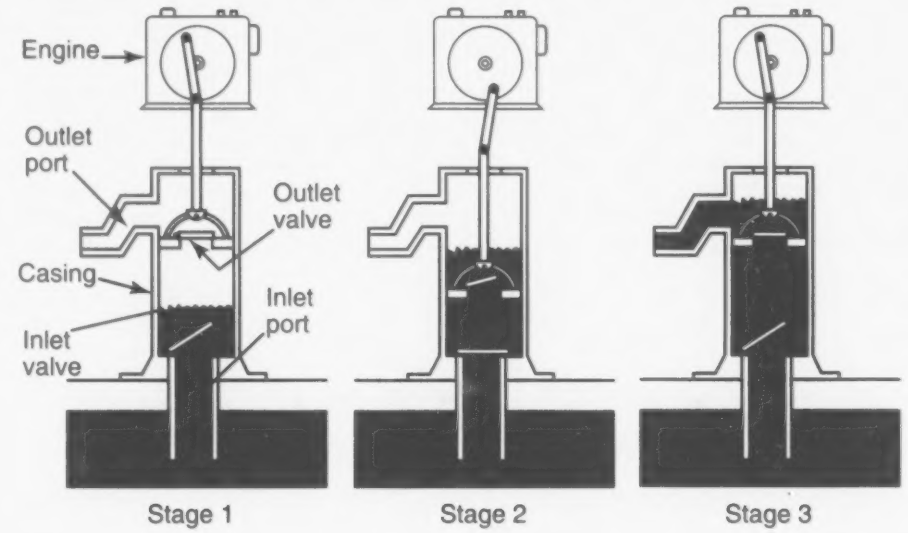
Figure 1: Common types of water pumps



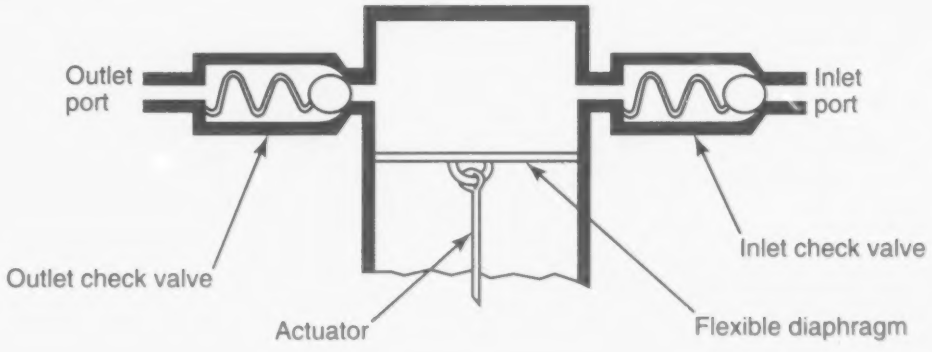
a. **Centrifugal pump**

b. **Rotary pump**

Figure 2: Common types of water pumps (cont.)



a. **Reciprocating pump**



b. **Diaphragm pump**

Information Sheet

3. Principles of operation of common types of water pumps

- **Centrifugal** (see Figure 1-a on page 50)

  Note: Most centrifugal water pumps must be primed—water must be present on the pump components before the pump begins to operate. Because the pump components are water lubricated and cooled, to operate the pump without water would damage these components. Two types of priming processes are used with centrifugal pumps: (1) manual and (2) self-primed. In the manual process, the operator must add water to the pump components before the pump begins to operate, but self-primed pumps have a reservoir that holds a supply of water that is fed to the pump components as the pump begins to operate.

  — Rotary motion from the engine turns the engine-output shaft that runs through the center of the pump body; an impeller mounted to the shaft rotates as the shaft turns.

  — The rotating impeller creates low pressure behind the impeller blades; the low pressure draws water into the pump body through a water-inlet port near the shaft.

  — Centrifugal force causes the water to move toward the outside edges of the rotating impeller; the impeller blades push the water through the water-outlet port.

    Note: At first glance, the curve of the impeller blades may appear to be backwards. However, the blades are not curved to scoop water as you might think; they are curved to create the largest open space at the outside edges of the impeller, thus allowing a greater volume of water to be moved to this area and to be carried to the outlet port.

- **Rotary** (see Figure 1-b on page 50)

  — Rotary motion from the engine turns an engine-output shaft that runs through the pump body at a point that is offset from the center of the pump body; a wheel that has either gear teeth or vanes that extend and retract turns within the pump body.

  — Water enters the pump body through the water-inlet port; the rotating wheel moves the water from the water-inlet port to the smaller area of the pump body that is created by the offset position of the engine-output shaft, increasing the pressure on the water and the velocity of the water's movement.

  — The wheel's gear teeth or vanes sweep the water toward the water-outlet port.

- **Reciprocating** (see Figure 2-a on page 51)

  — Rotary motion from the engine is converted to reciprocating (up and down) motion; the reciprocating motion is transmitted to a rod that is connected to a piston.

  — The up stroke of the piston forces air out of the cylinder, and the resulting low pressure within the cylinder draws water into the cylinder through the water-inlet port and valve.

  — The down stroke of the piston closes the water-inlet port and valve, trapping the water in the cylinder below the piston and increasing the water pressure there; the increased pressure opens the water-outlet valve in the piston, which allows water to flow into the cylinder above the piston.

  — The next up stroke of the piston forces the water trapped above the piston through the water-outlet port and draws water into the bottom of the cylinder.

Information Sheet

- **Diaphragm** (see Figure 2-b on page 51)
  - — A reciprocating shaft driven by the engine pulls the diaphragm away from the pump chamber, creating a larger volume and lower pressure in the chamber.
  - — Fluid at higher pressure forces its way into the pump chamber past the inlet valve.
  - — The reciprocating shaft pushes the diaphragm toward the pump chamber, decreasing the volume of the chamber and increasing the pressure.
  - — The increased pressure and smaller volume force fluid past the outlet valve.

4. **Typical service procedures required for water pumps**
   - Service engine
   - Adjust mechanical linkages
   - Lubricate moving parts
   - Replace worn or broken parts
   - Replace seals
   - Clean or replace filters or screens
   - Test output

5. **Major components of air compressors and their functions** (see Figure 3 on the next page)
   - **Engine**—Provides the rotary power to turn the engine-output shaft
   - **Engine-output shaft**—Transmits the rotary power from the engine to the compressor
   - **Air intake**—Allows outside air to enter the compressor
   - **Filter**—Removes dirt and contaminants from the intake air
   - **Block**—Houses the crankshaft, piston assembly, and cylinder
   - **Head**—Encloses the cylinder and houses the valves
   - **Air-inlet valve**—Allows air to enter the cylinder
   - **Air-outlet valve**—Allows compressed air to exit the cylinder
   - **Reservoir**—Stores the compressed air
   - **Pressure gauge**—Displays the pressure of the compressed air stored in the reservoir
   - **Relief valve**—Releases excess pressure
   - **Unloader valve**—Diverts compressed air from the reservoir when the desired relief pressure is reached

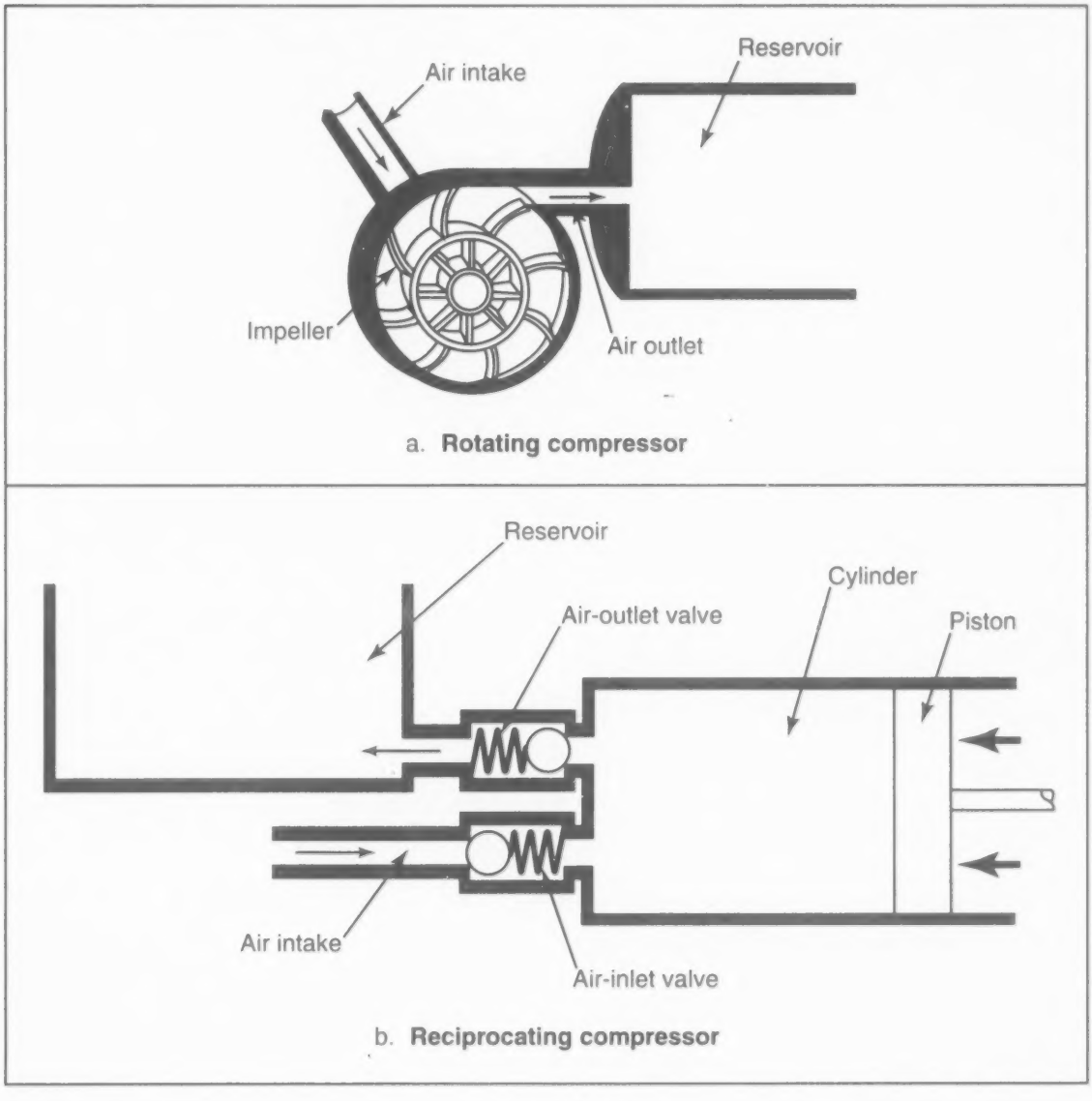
Information Sheet

6. Common types of air compressors

Note: Rotating and reciprocating are the two types of air compressors most commonly used in field applications. Rotating-air-compressor applications are limited to low- and medium-pressure systems, but reciprocating air compressors can be used for virtually any level of air pressure.

- **Rotating** (see Figure 3-a)
- **Reciprocating** (see Figure 3-b)

Figure 3: Common types of air compressors



Information Sheet

7. Principles of operation of common types of air compressors

- **Rotating** (see Figure 3-a on the previous page)

  — Rotary motion from the engine turns the engine-output shaft that passes through the compressor body; an impeller mounted to the engine-output shaft rotates as the shaft turns.

  — The rotating impeller draws air into the compressor body through an air-inlet valve near the axis of the impeller.

  Note: Moving air has lower pressure than still air. Air outside the air compressor forces its way in through the inlet to replace the air that is moved by the impeller.

  — Centrifugal force causes the air to move toward the edges of the rotating impeller; the impeller forces the air through the air-outlet valve and into the reservoir.

- **Reciprocating** (see Figure 3-b on the previous page)

  — Rotary motion from the engine is converted to reciprocating (up and down) motion; the reciprocating motion is transmitted to a rod that is connected to a piston.

  — The up stroke of the piston (movement of the piston away from the valves) produces low pressure within the cylinder, and the resulting low pressure within the cylinder draws air into the cylinder through the one-way check valve in the air-inlet valve.

  — The down stroke of the piston (movement toward the valves) compresses the air inside the cylinder and increases the air pressure; the increased air pressure forces the air-inlet valve to close but opens the one-way check valve in the air-outlet valve, which allows the air under pressure to exit the cylinder and enter the reservoir.

  — The next up stroke of the piston closes the air-outlet valve and opens the air-inlet valve, again creating low pressure in the cylinder.

8. Typical service procedures required for air compressors

- Service engine
- Adjust mechanical linkages
- Lubricate moving parts
- Replace worn or broken parts
- Replace seals
- Clean or replace filters or screens
- Test unloader valve
- Drain water from the tank

Information Sheet

9. **Safety rules for working with water pumps and air compressors**

   - **Do not touch hot engines or friction-heated parts of water pumps and air compressors.**

   - **Be aware of high-pressure hazards from water pumps and air compressors, especially with hoses and connections.**

     Note: Though most hydraulic and pneumatic pressures produced by water pumps and air compressors are not high enough to cause injury to arms and legs, they are high enough to damage eyes and other sensitive body parts. These pressures are also high enough to cause the equipment hoses to whip around or to blow out seals, which can create dangers from flying objects.

   - **Observe safety precautions for the flammable or toxic materials used in construction operations.**

     Note: Many of the materials used in the construction trades contain flammable or toxic substances. While the service technician may not normally expect to work with these flammable or toxic materials, the equipment being serviced may contain or may be contaminated by these materials. For example, the tanks of water pumps and air compressors may contain toxic or flammable materials.

Water Pumps and Air Compressors
Unit 2

Assignment Sheet 1—Determine Water-Pump and Air-Compressor Service Specifications and Parts Requirements

Name _____ Date _____

Evaluation criteria	Rating
Directions have been followed.	_____
Minimum of 85 percent of answers are correct.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Introduction

Many types of power product equipment are used to provide compression and pumping functions. Some are common throughout the country and some are found most often in certain areas of the country or in either urban or rural areas. For this reason, the types of compressors and pump equipment that a technician must service can vary greatly. Your training facility and your future work experience may or may not expose you to all of the equipment covered in this unit, and it is quite likely that you will encounter types of equipment not mentioned in these materials. This assignment sheet is intended to help you learn more about the compressors and pump equipment commonly used in your region of the country. Using equipment assigned by your instructor, you will determine part numbers, specifications, and other service-related information about that equipment.

Exercise

Directions

Your instructor will complete the first three blanks for each section of this assignment sheet. Using the resources available in your facility, determine the part numbers and specifications requested in questions 1 through 10 of each section. Write your answers on the blanks provided with each question.

Assignment Sheet 1

Part A

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

3. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

4. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

5. What is the recommended idle rpm?

   Idle rpm — _____

6. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

7. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Assembly type(s) — _____

      _____

Assignment Sheet 1

b. If pneumatic tires are used, what is the recommended inflation?

Recommended inflation — _____

c. What is the recommended lubricant for the wheel bushings or bearings?

Recommended lubricant — _____

d. What is the recommended lubrication-service interval?

Service interval — _____

8. What is the major driven component and its part number?

Examples: Reciprocating piston, impeller blade, diaphragm, etc.

Driven component — _____

Part number — _____

9. What type of operator controls are provided, and what service procedures are associated with them?

Operator controls — _____

_____

_____

Required service procedures — _____

_____

_____

10. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

_____

_____

_____

_____

_____

Assignment Sheet 1

Part B

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

3. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

4. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

5. What is the recommended idle rpm?

   Idle rpm — _____

6. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

7. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Assembly type(s) — _____

      _____

Assignment Sheet 1

b. If pneumatic tires are used, what is the recommended inflation?

Recommended inflation — _____

c. What is the recommended lubricant for the wheel bushings or bearings?

Recommended lubricant — _____

d. What is the recommended lubrication-service interval?

Service interval — _____

8. What is the major driven component and its part number?

Examples: Reciprocating piston, impeller blade, diaphragm, etc.

Driven component — _____

Part number — _____

9. What type of operator controls are provided, and what service procedures are associated with them?

Operator controls — _____

_____

_____

Required service procedures — _____

_____

_____

10. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

_____

_____

_____

_____

_____

Assignment Sheet 1

Part C

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

3. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

4. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

5. What is the recommended idle rpm?

   Idle rpm — _____

6. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

7. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Assembly type(s) — _____

Assignment Sheet 1

b. If pneumatic tires are used, what is the recommended inflation?

Recommended inflation — _____

c. What is the recommended lubricant for the wheel bushings or bearings?

Recommended lubricant — _____

d. What is the recommended lubrication-service interval?

Service interval — _____

8. What is the major driven component and its part number?

Examples: Reciprocating piston, impeller blade, diaphragm, etc.

Driven component — _____

Part number — _____

9. What type of operator controls are provided, and what service procedures are associated with them?

Operator controls — _____

_____

_____

Required service procedures — _____

_____

_____

10. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

_____

_____

_____

_____

_____

Water Pumps and Air Compressors
Unit 2

Job Sheet 1—Perform Routine Maintenance on Water Pumps

Introduction

This job sheet covers the routine maintenance associated with water pumps. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Inspect pump condition
- Check for leaks
- Adjust belt tension
- Align pulleys, shafts, and couplings
- Test output

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of performing routine maintenance on water pumps and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one water pump. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with a water pump that requires routine maintenance.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 1

Worksheet—Perform Routine Maintenance on Water Pumps

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code - _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 1

Worksheet—Perform Routine Maintenance on Water Pumps

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Water Pumps and Air Compressors
Unit 2

Job Sheet 2—Repair Water Pumps

Introduction

This job sheet covers the repair procedures associated with water pumps. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Replace pump components, hoses, etc.
- Overhaul engine and pump
- Perform adjustments to return equipment to original specifications

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of repairing water pumps and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one water pump. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with a water pump that requires repair.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 2

Worksheet—Repair Water Pumps

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 2

Worksheet—Repair Water Pumps

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Water Pumps and Air Compressors
Unit 2

Job Sheet 3—Perform Routine Maintenance on Air Compressors

Introduction

This job sheet covers the routine maintenance associated with air compressors. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Inspect and adjust belts, pulleys, and shafts
- Drain tank
- Check fluid levels
- Inspect and clean filters
- Inspect hoses
- Check operation of unloader valve
- Drain water separator
- Change fluids as required

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of performing routine maintenance on air compressors and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one air compressor. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with an air compressor that requires routine maintenance.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 3

Worksheet—Perform Routine Maintenance on Air Compressors

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Air Compressors

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Water Pumps and Air Compressors
Unit 2

Job Sheet 4—Repair Air Compressors

Introduction

This job sheet covers the repair procedures associated with air compressors. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Replace filters
- Replace hoses
- Replace seals
- Replace unloader valve
- Overhaul engine
- Overhaul compressor, including replacing piston and rings, connecting rod, crankshaft, etc.
- Perform adjustments to return equipment to original specifications

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of repairing air compressors and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one air compressor. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with an air compressor that requires repair.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 4

Worksheet—Repair Air Compressors

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 4

Worksheet—Repair Air Compressors

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Alternators, Generators, and Welding Equipment
Unit 3

Objective Sheet

Unit objective

After completing this unit, the student should be able to describe the design and operation of alternators, generators, and welding equipment and be able to perform routine maintenance and service procedures on such equipment. The student should demonstrate these competencies by completing the assignment sheet and job sheets and by scoring a minimum of 85 percent on the written test.

Specific objectives

After completing this unit, the student should be able to

1. Match terms associated with alternators, generators, and welding equipment to their correct definitions.
2. State safety rules for working with electrical equipment.
3. State definitions of the types of generators.
4. State the functions of the major components of generators.
5. Complete statements about the principles of operation of generators.
6. Describe ways of classifying generators.
7. Describe types of rectifiers.
8. List the typical service procedures required for alternators and generators.
9. State the functions of the major components of welders.
10. List types of welders.
11. Complete statements about the principles of operation of welders.
12. List the typical service procedures required for welders.
13. Determine alternator, generator, and welding-equipment service specifications and parts requirements. (Assignment Sheet 1)
14. Perform routine maintenance on alternators and generators. (Job Sheet 1)
15. Repair alternators and generators. (Job Sheet 2)
16. Perform routine maintenance on welders. (Job Sheet 3)
17. Repair welders. (Job Sheet 4)

Alternators, Generators, and Welding Equipment
Unit 3

Information Sheet

1. **Terms and definitions associated with alternators, generators, and welding equipment**

   - **Alternating current (AC)**—Electrical current that switches direction of flow
   - **Arc welding**—Process by which an electric arc is used to produce the heat required to melt the materials to be welded
   - **Capacitor**—Device used to store excess electrical charge
   - **Commutator**—Component of a generator usually consisting of a metal ring that is split and the two halves are electrically insulated from each other so that the half that is electrically active changes at the same time that electrical flow reverses direction so that the output of the generator flows in one direction only
   - **Direct current (DC)**—Electrical current that flows in one direction only
   - **Induction**—Production of electricity through the influence of a magnetic field
   - **Rectifier**—Device used to convert alternating current to direct current
   - **Resistance welding**—Process by which an electrode is placed on each side of two metals to be joined so that the heat produced as electrical current flows from one piece of metal to the other causes the metals to melt and bond
   - **Rotor**—Portion of an inductive electrical device that rotates
   - **Stator**—Portion of an inductive electrical device that remains stationary

     Note: Recall from your studies of charging systems that one common method of generating electricity is to move a conductive coil and a magnetic field relative to each other in a process called *electromagnetic induction*. The coil, sometimes called an *armature*, is generally copper wire wrapped around an iron core, while the magnetic poles are usually referred to as the *field*. Generators may use either a moving coil or a moving field. Thus, the coil may be either the rotor or the stator. The same is true of the field.

   - **Welding**—Process of joining two or more metal parts, usually by means of heat

2. **Safety rules for working with electrical equipment**

   - **Read and follow the manufacturer's recommendations for operation and use of the equipment.**
   - **Do not use electrical equipment in standing water or on wet surfaces.**
   - **Observe polarity requirements when making connections.**

     Note: Reversing electrical connections can damage equipment and can lead to arcing, which may cause burns, ignite flammable vapors, or damage nearby equipment.

- **Check all cables, cords, and exposed wiring for adequate insulation, and repair or replace defective wiring.**

- **Use protective devices of the specified ratings.**

  Example: 25-amp circuit breakers or fuses for 25-amp circuits

- **Do not attempt to hold circuit breakers closed if they have tripped.**

  Note: Circuit breakers are designed to protect circuits from overheating and excessive currents. Holding them closed may damage the equipment.

- **Handle one connection at a time whenever possible.**

  Note: Handling one connection at a time reduces the chances of touching the connections together and completing the circuit, the possibility of reversing polarities, and grounding a circuit through your body.

- **Discharge capacitors according to the manufacturer's prescribed procedures before removing if possible or immediately upon removal.**

  Note: Capacitors store excessive charge. The voltage stored in a capacitor may be large enough to cause injury or equipment damage. Even if the voltage is low, an unexpected discharge may lead to an accident if the technician is surprised.

3. **Types of generators and their definitions**

Note: Because generators and alternators use electromagnetic induction in order to produce electricity, the direction of electrical flow changes each time the relationship between the coil and the magnetic poles switches as the rotor turns. The direction of electrical flow will change with each half rotation of the rotor, thus producing alternating current (AC). All portable generators and alternators produce AC, though specific devices may provide direct current (DC) by rectifying the AC or may provide both AC and DC output. If the device outputs AC, it is usually referred to as an *alternator* or *AC generator*. In general practice, power product equipment portable AC generators are referred to simply as *generators*. This practice is followed in this unit, where the term *generator* can be understood to refer to an AC generator unless otherwise described.

- **AC generator**—Generator that outputs alternating current

- **DC generator**—Generator that uses a rectifier circuit or commutator to output direct current

Information Sheet

4. **Major components of generators and their functions** (see Figure 1)

Figure 1: Major components of generators

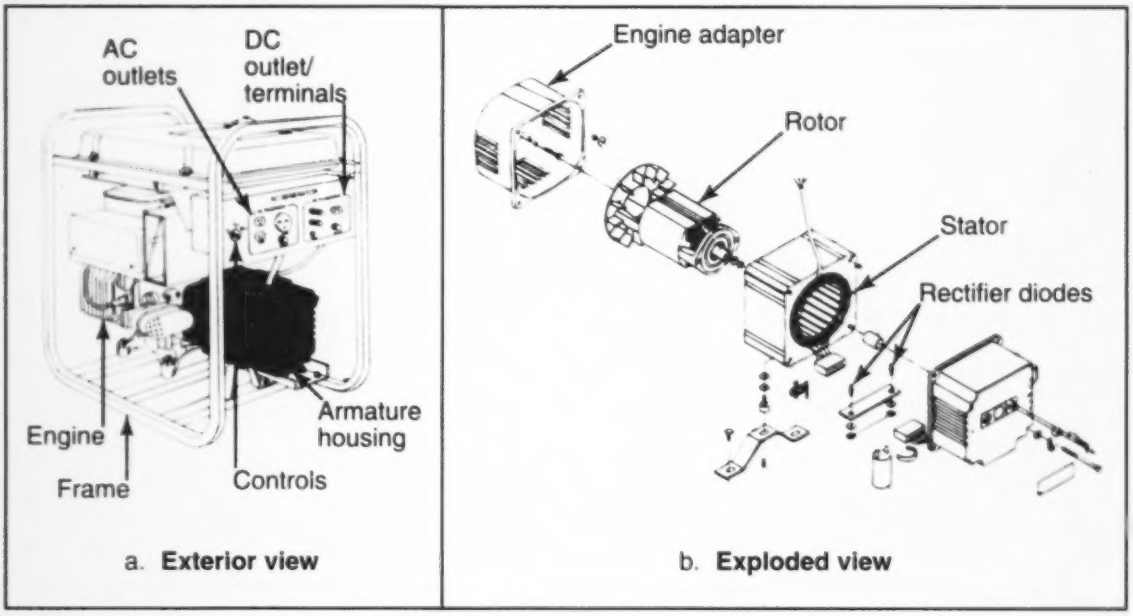


Figure 1-b reproduced with permission of Coleman Powermate, Inc., Kearney, Nebraska.

- **Housing**—Provides protection and support for electrical and electronic components

  Note: The housing prevents contact with most electrical hazards in the generator and protects its components from the elements. Generally, the housing holds the stator and provides a means for the rotor to turn, such as bushings or bearings that support the rotor shaft. The housing may also enclose the control circuitry and electronic components. In some designs, the housing encases the engine as well. The housing usually provides conveniences for transporting the generator, such as support rails, wheels, or carrying handles.

- **Engine**—Provides the power for the production of electricity

- **Rotor**—Rotates as a result of power output from the engine and provides electrical coil or magnetic field for induction of electrical flow

  Note: Figure 1 shows a portable generator that uses a rotating coil or armature to produce electricity. However, many portable generators use a rotating field. In either case, the field consists of two poles that create the magnetic force required for electrical induction.

- **Stator**—Remains stationary and provides electrical coil or magnetic field for induction of electrical flow

- **Rectifier circuit**—Converts alternating current to direct current

  Note: The generator circuitry may include a means of rectifying the AC output of its magnetic induction. The rectifying circuit may be a commutator, a rectifier, or a diode or set of diodes (see Figure 1-a). Some generators allow the rectifying circuit to be bypassed so that AC power is output. Some generators also contain voltage regulators to help maintain stable electrical output.

- **Controls**—Allow the operator to operate the generator and adjust its functions

  Note: Most portable generators are equipped with a control panel that provides switches for operating the equipment and often indicators to inform the operator of the status of equipment functioning. The control panel may include a switch for starting and stopping the engine or adjusting electrical characteristics, such as output-voltage level.

- **AC outlets**—Provide access to alternating current

  Note: The generator may provide one outlet into which power cords may be plugged. Some generators offer a variety of outlets for different types of electrical cords, especially if a generator produces more than one voltage level.

- **DC-outlet/terminals**—Provide access to direct current

  Note: Generators that provide direct current by rectifying AC generally provide two types of power outlets. DC terminals consist of a positive and a negative pole and are often used to charge batteries or to operate DC equipment with polar connections, such as electric motors. The generator may also have an outlet for two-prong DC electrical cords.

5. Principles of operation of generators

- The engine output is used to turn the coil or the field; the movement of the rotor in relation to the stator produces electricity through electromagnetic induction.
- As the rotor completes one-half of a rotation, the polar relationship between the field and the coil changes, causing the current flow to reverse direction.
- To provide AC power, the alternating current is conducted to an output circuit, such as an outlet.
- To provide DC power, the alternating current is rectified through the use of a commutator or a rectifying circuit.
- The rectified current is conducted to an output circuit such as an electrical socket or power line.

6. Ways of classifying generators and their descriptions

Note: The two most common ways of classifying generators are on the basis of their induction method and on the basis of the phasing of their output.

- **Induction method**
  - — A stationary field within which the coil rotates
  - — A stationary coil within which the field rotates

- **Output phasing**

  Note: A generator will produce a current wave for each winding on the coil so that the output phasing is determined by how the windings are arranged in relationship to each other.

  — Single-phase output using a single winding

  — Two-phase output using two windings set at 90-degree angles to each other

  — Three-phase output using three windings arranged at 120-degree angles to each other

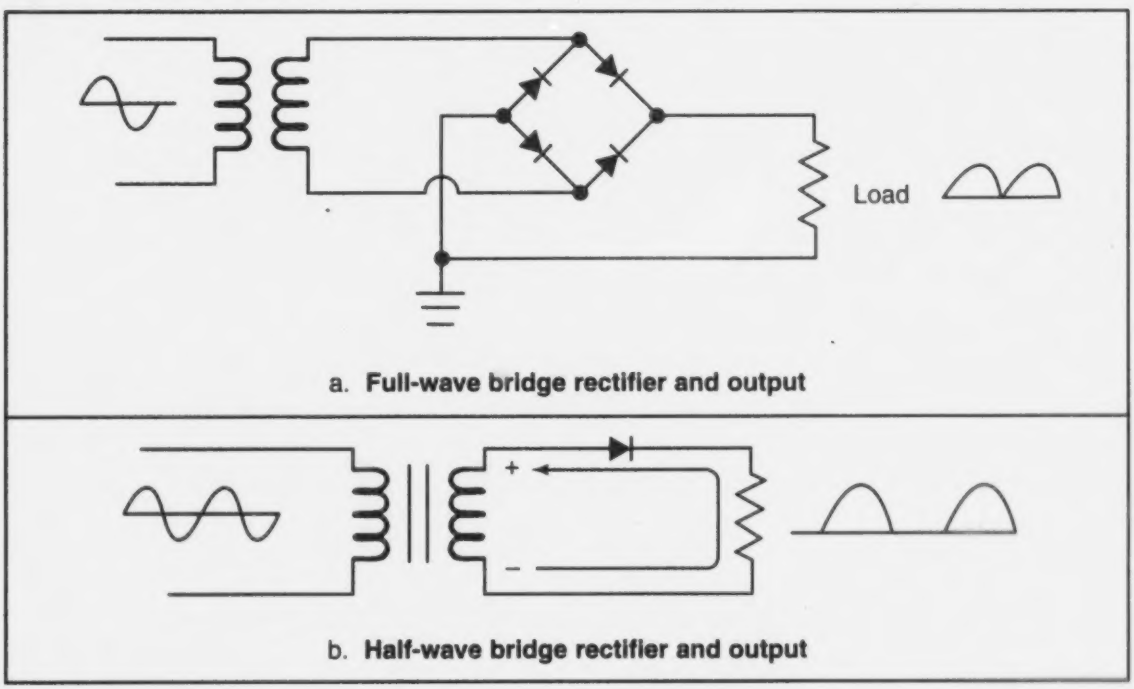
  Note: The most common form of commercial power in North America is three-phase power.

7. Types of rectifiers and their descriptions

- **Diode**—An electrical component that allows electrical flow in one direction only so that just half of an alternating current is allowed to complete the circuit
- **Silicon-controlled rectifier**—Semiconductor device that is normally an open circuit until voltage is applied, at which time the circuit closes to conduct current in only one direction
- **Bridge rectifier**—Circuit generally consisting of four diodes arranged in such a way that an alternating-current input produces only direct-current output

  Note: The two major types of bridge rectifiers are the full-wave and the half-wave bridge. Figure 2 shows the circuit configuration for each type. Note that the full-wave bridge allows transmission of the full AC cycle, while the half-wave bridge outputs only half of the AC energy.

Figure 2: Bridge rectifiers



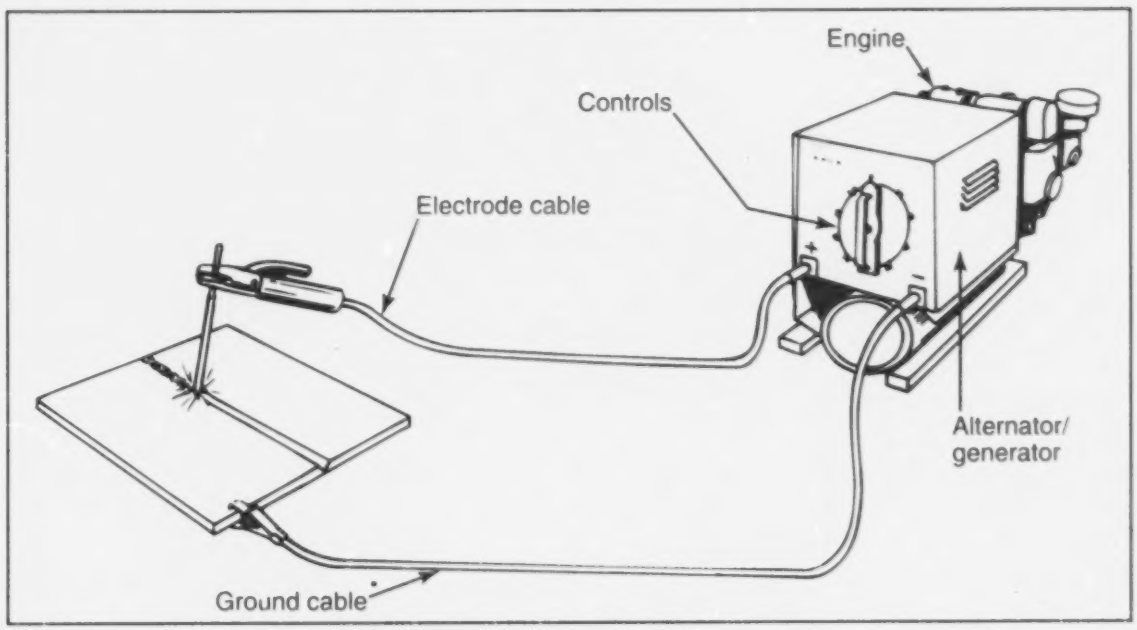
a. **Full-wave bridge rectifier and output**

b. **Half-wave bridge rectifier and output**

Information Sheet

8. **Typical service procedures required for alternators and generators**
   - Service engine
   - Adjust belt tension
   - Lubricate moving parts
   - Test output
   - Replace fuses
   - Overhaul rotor
   - Replace brushes
9. **Major components of welders and their functions** (see Figure 3)

Figure 3: Major components of welders



- **Engine**—Provides power to the alternator/generator
- **Alternator/generator**—Produces electricity as a source of heat production for welding
- **Controls**—Allow the operator to determine the settings for the equipment

  Note: Depending on the type of welder, the controls may allow the operator to select the current or voltage, type of current, type of welding, and other factors.
- **Electrode cable**—Holds the electrode to provide the current to work and to provide material for the weld
- **Ground cable**—Completes the circuit between the welding equipment and through the work

Information Sheet

10. Types of welders

Note: Welding machines are generally classified by (1) the type of welding for which they are suited, (2) whether their current is constant current or constant voltage, and (3) whether the output is AC, DC, or selectable as either AC or DC. For power product equipment welding machines (also called *motor-generator welding machines*), the most common welding technique is arc welding, with some process variations gained by whether or not the machine is equipped with a wire feeder. Further, the majority of power product equipment welding machines use constant current output. Thus, the primary distinction among motor-generator welding machines is the type of current they produce for the welding energy.

- **DC welder**
- **AC welder**
- **AC/DC welder**

11. Principles of operation of welders

- The engine drives the coil or field shaft of the generator or alternator.
- The output of the generator or alternator may be rectified if DC output is desired, or the output may be conditioned through a voltage regulator.
- Electrical current is provided to the work or the electrode, depending on the polarity of a DC welder or setup of an AC welder.
- Current arcs between the work and electrode, causing an extremely high temperature that melts the metal of the work.

  Note: The electrode may be consumable or refractory. Consumable electrodes melt during the process and add filler material to the weld joint. Refractory electrodes are made of metals such as tungsten or carbon, which have melting points in excess of the temperature of the weld. The electrode cable may also house hoses for delivering gas to the weld site.

- The ground cable completes the circuit to the welder.

12. Typical service procedures required for welders

- Service engine
- Adjust belt tension
- Lubricate moving parts
- Test output
- Replace fuses
- Overhaul rotor
- Replace brushes
- Replace cables and electrodes

Alternators, Generators, and Welding Equipment
Unit 3

Assignment Sheet 1—Determine Alternator, Generator, and Welding-Equipment Service Specifications and Parts Requirements

Name _____ Date _____

Evaluation criteria	Rating
Directions have been followed.	_____
Minimum of 85 percent of answers are correct.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Introduction

Many types of power product equipment are used to produce electrical current and for welding. Some are common throughout the country and some are found most often in certain areas of the country or in either urban or rural areas. For this reason, the types of electrical-generating and welding equipment that a technician must service can vary greatly. Your training facility and your future work experience may or may not expose you to all of the equipment covered in this unit, and it is quite likely that you will encounter types of equipment not mentioned in these materials. This assignment sheet is intended to help you learn more about the alternators, generators, and welding equipment commonly used in your region of the country. Using equipment assigned by your instructor, you will determine part numbers, specifications, and other service-related information about that equipment.

Exercise

Directions

Your instructor will complete the first three blanks for each section of this assignment sheet. Using the resources available in your facility, determine the part numbers and specifications requested in questions 1 through 12 of each section. Write your answers on the blanks provided with each question.

Assignment Sheet 1

Part A

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. For electrical-generating equipment, what is the maximum voltage output?

   Maximum output — _____

3. For welding equipment, what type of welding is this equipment suited for?

   Type of welding — _____

4. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

5. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

6. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

7. What is the recommended idle rpm?

   Idle rpm — _____

8. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

Assignment Sheet 1

9. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Type(s) used — _____

      _____

   b. If pneumatic tires are used, what is the recommended inflation?

      Recommended inflation — _____

   c. What is the recommended lubricant for the wheel bushings or bearings?

      Recommended lubricant — _____

   d. What is the recommended lubrication-service interval?

      Service interval — _____

10. What is the major driven component and its part number?

    Examples: Coil, field, etc.

    Driven component — _____

    Part number — _____

11. What type of operator controls are provided, and what service procedures are associated with them?

    Operator controls — _____

    _____

    _____

    Required service procedures — _____

    _____

    _____

12. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

    _____

    _____

    _____

    _____

Assignment Sheet 1

Part B

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. For electrical-generating equipment, what is the maximum voltage output?

   Maximum output — _____

3. For welding equipment, what type of welding is this equipment suited for?

   Type of welding — _____

4. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

5. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

6. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

7. What is the recommended idle rpm?

   Idle rpm — _____

8. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

Assignment Sheet 1

9. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Type(s) used — _____

      _____

   b. If pneumatic tires are used, what is the recommended inflation?

      Recommended inflation — _____

   c. What is the recommended lubricant for the wheel bushings or bearings?

      Recommended lubricant — _____

   d. What is the recommended lubrication-service interval?

      Service interval — _____

10. What is the major driven component and its part number?

    Examples: Coil, field, etc.

    Driven component — _____

    Part number — _____

11. What type of operator controls are provided, and what service procedures are associated with them?

    Operator controls — _____

    _____

    _____

    Required service procedures — _____

    _____

    _____

12. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

    _____

    _____

    _____

    _____

Assignment Sheet 1

Part C

Type of equipment _____

Manufacturer _____

Model number _____

1. What company manufactures the engine for this equipment, and what is the engine model and horsepower?

   Manufacturer — _____

   Engine model/horsepower — _____

2. For electrical-generating equipment, what is the maximum voltage output?

   Maximum output — _____

3. For welding equipment, what type of welding is this equipment suited for?

   Type of welding — _____

4. What is the recommended spark plug and gap for the assigned equipment?

   Recommended spark plug — _____

   Spark-plug gap — _____

5. What type of equipment drive (belt, chain, gear, etc.) is used, and what is the part number for the principal drive mechanism?

   Equipment drive — _____

   Part number — _____

6. What type of starter system does the equipment use, and what is the part number for the recoil string or starter motor?

   Starter system — _____

   Part number — _____

7. What is the recommended idle rpm?

   Idle rpm — _____

8. What is the recommended oil viscosity and capacity for the equipment?

   Oil viscosity — _____

   Capacity — _____

Assignment Sheet 1

9. Consider the tire and wheel assemblies, if used.

   a. What type(s) of tire and wheel assembly is used?

      Type(s) used — _____

      _____

   b. If pneumatic tires are used, what is the recommended inflation?

      Recommended inflation — _____

   c. What is the recommended lubricant for the wheel bushings or bearings?

      Recommended lubricant — _____

   d. What is the recommended lubrication-service interval?

      Service interval — _____

10. What is the major driven component and its part number?

    Examples: Coil, field, etc.

    Driven component — _____

    Part number — _____

11. What type of operator controls are provided, and what service procedures are associated with them?

    Operator controls — _____

    _____

    _____

    Required service procedures — _____

    _____

    _____

12. Describe any special service procedures or specifications required in the routine maintenance of this equipment.

    _____

    _____

    _____

    _____

Alternators, Generators, and Welding Equipment
Unit 3

Job Sheet 1—Perform Routine Maintenance on Alternators and Generators

Introduction

This job sheet covers the routine maintenance associated with alternators and generators. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Inspect mechanical and electrical components
- Lubricate bearings
- Adjust belt tension
- Align pulleys and shafts

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.
2. Watch your instructor's demonstration of performing routine maintenance on alternators and generators and any supporting media provided by your instructor.
3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one alternator or generator. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.
4. Ask your instructor to provide you with an alternator or generator that requires routine maintenance.
5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.
6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.
7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 1

Worksheet—Perform Routine Maintenance on Alternators and Generators

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 1

Worksheet—Perform Routine Maintenance on Alternators and Generators

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Alternators, Generators, and Welding Equipment
Unit 3

Job Sheet 2—Repair Alternators and Generators

Introduction

This job sheet covers the repair procedures associated with alternators and generators. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Test electrical output
- Separate alternator or generator from engine or equipment
- Flash a brush-type generator
- Replace bushings and bearings
- Replace brushes
- Repair or replace wiring
- Perform adjustments to return equipment to original specifications

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of repairing alternators and generators and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one alternator or generator. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with an alternator or generator that requires repair.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 2

Worksheet—Repair Alternators and Generators

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 2

Worksheet—Repair Alternators and Generators

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Alternators, Generators, and Welding Equipment
Unit 3

Job Sheet 3—Perform Routine Maintenance on Welders

Introduction

This job sheet covers the routine maintenance associated with welders. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Inspect mechanical-drive components
- Adjust control circuitry
- Clean cooling circuits

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.
2. Watch your instructor's demonstration of performing routine maintenance on a welder and any supporting media provided by your instructor.
3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one welder. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.
4. Ask your instructor to provide you with a welder that requires routine maintenance.
5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.
6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.
7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 3

Worksheet—Perform Routine Maintenance on Welders

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 3

Worksheet—Perform Routine Maintenance on Welders

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Alternators, Generators, and Welding Equipment
Unit 3

Job Sheet 4—Repair Welders

Introduction

This job sheet covers the repair procedures associated with welders. You will accomplish these tasks by following the appropriate procedures in the manufacturer's service manual. While the specific procedures will depend on the equipment design and manufacturer's processes, the general tasks that may be performed under this procedure include

- Replace components
- Overhaul subsystems, including engine, electrical circuitry, control circuitry, etc.
- Perform adjustments to return equipment to original specifications

Procedure

1. Study all of the objectives in the information sheet and complete Assignment Sheet 1.

2. Watch your instructor's demonstration of repairing a welder and any supporting media provided by your instructor.

3. Review the following worksheet associated with this job sheet. You may be required to accomplish this job sheet for more than one welder. Check with your instructor, and obtain a copy of the worksheet for each attempt that will be required.

4. Ask your instructor to provide you with a welder that requires repair.

5. Complete the pre-performance check (Part A) on the worksheet and receive your instructor's signed approval for the service information you have located and the equipment/materials you have listed for performing the procedure on the equipment assigned.

6. Review the evaluation criteria listed in the performance evaluation (Part B) on the worksheet.

7. Using the instructor-approved service information and equipment/materials list, perform the appropriate procedure. Your instructor will rate your performance using the evaluation criteria listed in the performance evaluation on the worksheet.

Job Sheet 4

Worksheet—Repair Welders

Name _____ Attempt number _____

Date _____

Part A: Pre-performance check

Job _____

- Complete the following information concerning the assigned equipment.

  Equipment brand _____

  Equipment model/type and code _____

  _____

- Complete the following service-manual information.

  Service-manual title _____

  Section/page number of procedure _____

- List type and number of replacement parts.

- List special equipment/materials required for procedure.

Instructor's signature _____

Job Sheet 4

Worksheet—Repair Welders

Part B: Performance evaluation

Evaluation criteria	**Rating**
Correct procedures identified for assigned equipment.	_____
Procedures completed correctly.	_____
Proper tools used correctly.	_____
Safety precautions observed.	_____
Service meets specifications.	_____
Clean-up and follow-up actions adequate.	_____
Overall rating	_____

Evaluator's comments _____

_____

_____

Power Product Equipment Technician Series

Theory and Principles of Engine Operation

Section A: Orientation

Section B: Basic Engine Theory and Operation

Engine Systems and Service

Section A: Engine Systems

Section B: Engine Overhaul

Equipment Systems

Construction Equipment

Lawn and Garden Equipment

MAVCC

1500 West Seventh Avenue
Stillwater, OK 74074-4364
1-800-654-3988

800062

99-013308